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BULLETIN No. I.

INDIANA STATE BOARD
OF FORESTRY

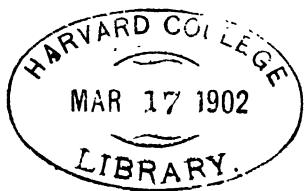


W. H. FREEMAN, *Secretary.*

1901

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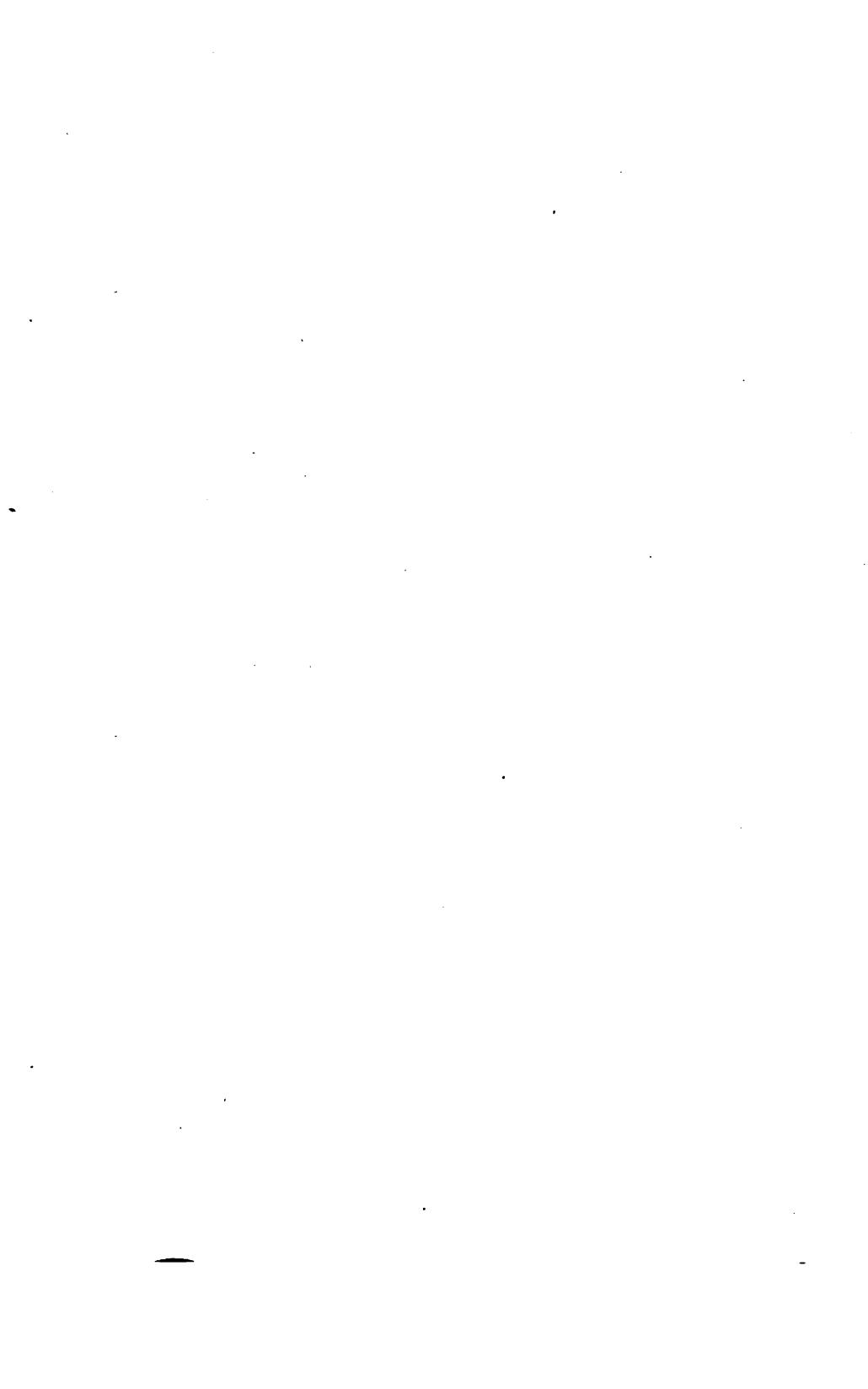
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INTRODUCTION.

This bulletin merely introduces the subject of Forestry to the commonwealth of Indiana. From the nature of the subject, the time and means at the disposal of the board, an extensive bulletin is at this time impossible.

We are satisfied of the importance of forestry to the general prosperity of the people, of the necessity for a decided action by all of the people in its promotion, and that a strong forestry sentiment is being formed throughout the State.

The press of the State has been generous in its effort to put before the people of the State information and admonition and to urge the fostering of the timber area and the sense of its right use. The United States Bureau of Forestry and those of several States have contributed their reports and bulletins to the office for file. The United States Bureau has allowed a mailing list of over 3,000 names from its list of publications and bulletins at the direction of the secretary, and has expressed a deep interest in the state work.

The local officers of the State have complied promptly to every inquiry for information by them available. Individual citizens have shown themselves willing by letters and words of encouragement.

To all of these we are appreciative and thankful, but unhesitatingly we acknowledge our inability to accomplish desired results, because of the small financial means afforded us for investigation, experiment and publication.

We appeal to the citizens of the State for an earnest consideration of the State's timber conditions and the necessity for a more rational use, cultivation and propagation in the future.

THE BOARD.

FORESTRY.

Forestry is a terminology much varied in meaning because of the conditions of definition. For a well wooded country, it may mean instruction, information and recommendations for removing and rational use of the wood crop. For a woodless region, it may apply exclusively to information for planting and growing forests. In other localities of compromise conditions it may mean all of these and additional features as well.

It is apparent to every intelligent person that such a business as the management of forest property can not be done without considering the business conditions as well as the physical. If a forest crop can not be marketed at a fair value, it will be useless to grow it from such a consideration.

The procedures under one set of conditions can not recommend themselves under another different set. Surrounding conditions largely determine. The person who plants a forest must also recognize that his business will be one of future realization. The crop which the forester grows is harvested many years from the time of planting. It is a question of working for future generations. But what could be more noble than to work and plan for the future good and welfare of posterity?

“Example is more efficacious than precept.”

Forestry then, involving as it does, future conditions, subject to time, patience and outlay can better be engaged in by capitalists and corporations, who are better able to carry forward a long-lived institution or continued interest.

A State can afford to wait for the time when expenditures and sacrifices of the present will bring their returns and can better afford to spend money on improvement. The same is true of the large capitalist. In this business the same as in any other, the size of the property has much to do with its value and profitableness.

Farmers of small areas can not carry on forestry from a money profit consideration but as a side business for beauty, general climatic conditions and common utility in protection and material.

The farmer who is occupied almost constantly at other duties can only engage in Forestry to the extent of spare days in cultivating and caring for his wood-lot, grove or other farm forests as he may find space and opportunity to plant, and as his land area contains portions suited to it.

Indiana in her richness of productive soil, equable climate and rainfall, presents no serious conditions. Forestry for Indiana is mostly a problem of its people. We have no mountain slopes and osier areas to engage us as many eastern States have. None of the arid plains and regions of irrigation difficulties of the western plains confront us. Ours is the problem of planting, cultivating and waiting.

But the greatest of all problems, the future prosperity of the State in her varied industry, is to be retained in a large, if not the larger part, by supplying forest material to the industries. Forestry is a large institution, it is one for the State, corporations and people collectively and individually, in the three-fold division of planting, cultivating and preservation of timber.

PURPOSE.

The purpose of Forestry, as is embodied in the Act which created and governs the Board, is a vital one to the State. The past history of Indiana has been one of the greatest abundance of hard-wood timber. The more than eighteen million acres of the best timber known to any State of the central group was the State's condition eighty-five years ago.

The timber has been so depleted in this short time that the best interests of all demand a rigid action in the rational use and preservation of the present supply and a vigorous afforesting movement begin. By reason, to a great degree, of the past large timber resources in the State, a diverse industry of the richest proportions is the opportunity of the people.

To promote these interests of every sort by the increase of and preservation of the timberland in the State, is the purpose of forestry as governed by the State Board. The purpose is clearly defined in the clause which says: "It shall be the duty of said board to collect, digest and classify information respecting forests, tim-

berlands, forest preservations and timber culture, and to recommend plans and methods for forest preservation and timber culture and for the establishment of State reserves."

The law further implies that the Board shall submit facts and information about forests and timber to timber dealers, woodworkers, farmers and engineers of maintenance of way of railroads.

In the fulfillment of the duties and the carrying out of the purpose of forestry, the board can do nothing beyond what the people wish and are willing to afford the opportunity of doing.

NECESSITY.

The necessity for an extensive forestry movement is sustained by the industrial conditions of the State. Of these causes, that of the manufacturing industry is the most vital. Indiana has, by reason of its hardwood timber, during the past, a large manufacturing industry established, using timber as the raw material of manufacture. It is a perfectly safe estimate that one-half of the aggregate manufacture of the State is a wood-finished product, exclusively, and that a large per cent. of the other manufacturers use timber in large quantities in sundry ways in making their finished products.

The wood manufacture in the State is extensive in operation and exhaustive in material demand. There are in the State a great number of manufactories of every gradation of wood articles, from the smallest novelty to the largest implement, railroad and ship-building construction. These institutions for raw material are sapping the State's resource of both virgin and second growth timber.

At the present time the timber of the State does not exceed one and one-half million acres of mostly second-growth stuff. The last statistics taken show a consumption of nearly a half million acres per year, and a large increase in the number of industries, capital investment, employment and wages paid in all the industries using second growth timber, and a like decrease in those using virgin timber. The fact, stated concisely, is a largely increasing manufacture, based on a small, rapidly decreasing material supply. Information and facts from our neighboring States show like conditions, and even greater in timber consumption.

The present high standard of industrial prosperity to our people can not long exist, unless a movement is made to keep the raw material supply sufficient for the demand, to those institutions demanding timber.

The State's population of seventy per square mile, is too great to retreat in the least from the present extensive manufacture to a more extended agriculture. Agriculture demands room for operation but manufacture demands material more than room. The present high plane triple industry of manufacture, agriculture and commerce affords such advantages of supply and demand to every citizen within the State, that no decline of manufacture can be tolerated without resulting detrimentally to the best interests of the State.

Much of the wood consumed, by reason of the quality in the timber and the article manufactured, can not be substituted.

Unless the timber can be secured, these industries must cease as opportunities to the people, so far as they are dependent on the State's supply of material. Every principle of trade applies as well. The extent of labor and price of product to the consumer is governed by the reasonableness for securing the raw material of operation. The increasing consumption of timber with the little activity at replenishment means extravagant prices for material, decreased investment in manufacture, less employment and advanced prices to the consumer for the finished product. All tend toward the necessity for a rigid forestry movement.

FOR AGRICULTURE.

Forestry as a means to a better agricultural security is equally as vital in importance as to manufacture. Agriculture is dependent on right climatic and soil conditions, more than any other industry. The lessened rainfall, of which the present year is more than four inches short, the lowered drainage of the State, the more frequent and violent storms of summer, the certain drouth, the diminished snowfall and fierce winds to disturb its lay on the ground, as protection to winter crops, are all things to a great degree influenced and heightened by the cutting away of the forests.

Forests by their foliage are sources of rain production, by transpiration and condensation. Their leaf cover prevents rapid evaporation of the rainfall and retains a more equable relative humidity. Trees by their roots and litter hold the water and direct it into the soil where it is stored for gradual use to streams and land, as against the rapid flowing over the surface into streams and away, causing erosion and doing the land no good, in disafforested regions. The diminished rainfall in itself does not cause such a marked change in the moisture conditions of summer, but it is the heightened evaporation resulting from clearing out the timberland, and removing the causes which retain the rainfall to the land.

Forests are great soil builders by the decay of their litter. They form brakes against the wind which drifts the snow and leaves winter crops exposed to freeze, and also against the violent storms of summer. Forests also protect orchards from winter freezing out and killing of fruit. The dying out of the orchards is stimulated by the changed climatic conditions from the even moderate climate of a few years ago to the extremes in freezing and drouth of the present.

Stock raising will be benefited by a better forest condition, through pasture supply and shelter as well as other agricultural business in general. A common sense survey of every line of agriculture will show the results of forest devastation and the urgent need of reforestation.

THE IMPORTANCE OF FORESTS TO OUR FRUIT CROPS.

MASON B. THOMAS.

An examination of the history of our fruit crops, together with that of the deforestation of our lands to determine if possible any connection between the two, results in the discovery of relations so striking and constant that there seems to be little question as to the very marked influence exerted by our forests on our fruit production.

Of the ten counties formerly producing the largest yield of apples, all contain a very large acreage of forests and some are among the heaviest timbered counties in the State.

The study of the variations in the fruit crops in these counties, in connection with the disappearance of their forests, substantiates the theory already stated. Those exhibiting the largest falling off in their apple crops also show nearly corresponding reductions in their forest areas. While this is not the history of all the counties in the State, it is certainly very suggestive that those counties that were once the producers of the largest apple crops and have suffered most from deforestation, have fallen to the end of the list in the amount of apples produced; and further, of those counties formerly producing the largest apple crops, those have fallen off the least that have removed the smallest amount of timber. These facts are too significant and constant to be simply coincident, and, in my judgment, do prove a very close relationship between the forest acreage and the fruit crops.

While many counties that are not heavily timbered now produce large apple crops, the raising of apples in those places is attended with difficulties that are not present in timbered districts. It is true that the forests are not indispensable to the production of a fruit crop, yet their presence contributes greatly to its best development. Harrison county, with the largest forest acreage of any county in the State, stands first in the size of its peach crop and second in its apple crop.

The influence of the forest is manifested in its moderating effects, in the preventing of sudden changes and great extremes of temperature. The forests also protect from chilling winds, and, by holding the snow, prevents the freezing of roots. The removal of forests in the vicinity of orchards has caused a reduction in the number of birds that once were abundant but are now driven to the forests at some distance away for their nesting places and seldom return to the fruit trees. These birds formerly destroyed a large number of insect pests that now work havoc with the tree and fruit and make the raising of perfect apples a matter of great difficulty. The presence of new insects in the State can not account for any irregularity in the decline in different counties, since a few years would permit the general distribution of the pest and affect all counties alike.

Twenty years ago we produced thirty-five million bushels of apples and from two to four million bushels of peaches, while now our crop is about one-half of one million bushels of apples and one

hundred thousand bushels of peaches. It is true that the difficulty in raising perfect apples has resulted in the reduction of the number of apple trees in the State by about twenty-five per cent., but this has not kept pace with the falling off of the annual yield which has been about forty-five per cent. These figures make clear to us the most reasonable line of action if we ever hope to become a great fruit-raising State.

RELATION OF FORESTS TO OUR STREAMS.

MASON B. THOMAS.

One of the most direct results from the destruction of our forests has been the variation in volume and regularity of our streams. While the amount of annual rainfall for the past fifty years has been varied but little, the method of its disposal has materially changed. Where formerly the precipitation was temporarily held in the great mass of roots and humus of the forest soil and gradually given to the streams as they carried off the more immediate supply, it now flows from our unprotected fields like rain from the highways, inundating the bottom lands and interfering with the agricultural interests of these localities. The denuding of the basins of our streams has also seriously interfered with their value as waterways. The upper portions no longer contain sufficient water to float the old-time flat-boat, and farther down the stream the channel is obstructed by shoals and the bars that make navigation out of the question. Our rivers do not now compete with the railroads in our commerce; a valuable industry is destroyed and we are poor because of it.

The Wabash river, our principal stream, draining nearly four-fifths of the State, extends northward from the Ohio in the southwestern part of the State and gives off numerous tributaries that reach nearly every part of our commonwealth. The east and north branches of White river extend to the central and southern parts, and the Wabash and Tippecanoe to the north and north-central parts. These streams were very important as waterways for commerce in the early history of the State. Boats of small draught reached Monticello on the Tippecanoe, Logansport on the Wabash,

Indianapolis on White river and on the east branch of White and Muscatatuck as far east as Scott county.

In the southeastern part of the State, White river was navigable to Brookville, and from all these points and the many small tributaries of these streams flat-boats carried great quantities of lumber, pork, corn, wheat, oats, fruit and hoop poles down the Mississippi to New Orleans while the returning steamers distributed great quantities of freight up these waterways into the interior of the State. To some extent the same is true of the Blue, Pigeon and other small streams in the southern part of the State. All this has passed away and we now have but few navigable streams. Our extensive system of underdrainage and the cultivation of open fields has contributed something to this change, but the removal of the forests from the river basins is by far the largest factor in the decline. Much of what we have lost could be regained by a systematic reforestation of all of the lands not suitable for agriculture along these streams, and this would in no way interfere with our agricultural interests. At the same time these unproductive lands could be made a profitable and permanent investment, yielding regular yearly returns from systematic cutting that would in no way impair their value.

FORESTS AND CLIMATE.

The effects of forests on climate has been satisfactorily proven. It has been determined that the soil temperature in forests is cooler and the variation less than in open fields. Evaporation in forests is but 44 per cent. of that in open fields. It has also been found that of the amount of annual rainfall 40 per cent. is evaporation from open fields, as against 12 per cent. from forest soil, while the amount of forests through evaporation and transpiration is near 75 per cent. of the annual precipitation.

The relative humidity in forests is not more than one-third as great in variation as that of disafforested regions. That forests exert an influence on climate is in accord with every law of cause and effect in climatic changes. There may be stated as follows: The quantity of heat received by the entire earth is the same for equal times in all parts of the orbit; a heavy atmosphere displaces

a lighter one; a cold atmosphere displaces a warmer; changes in material produce corresponding changes in climate; unequal distribution of land and water areas produce unequal climates; hot climates are most subject to violent storms; land areas take on heat from the sun more readily than do water areas and give it off more quickly; barren regions have greater extremes of temperature than do vegetated areas; temperatures near water areas are more equable, cooler in summer and warmer in winter, than that remote from it; rainfall is greater in vegetated areas and near water influences; cold air holds less of moisture than warm air; air cooling condenses and gives off its moisture while heated air expands and takes on or is capable of taking on more moisture.

A study of these laws of atmospheric changes and causes will afford convincing evidences that forests have in them the means of materializing parts of these laws and of correcting others in part. Forests stand in the same relation to climate as do bodies of water. They afford means of condensation, transpiration, source of moisture and at the same time they prevent evaporation, heated surface conditions and afford equable conditions for creating influences.

Forests by their influences are safeguards against violent storms, drouths and freezes, thus affecting immediately farming interests in every phase.

It must not be construed that rainfall can be produced by planting forests. It is simply a fact that forests foster conserving influences to the soil and save the rainfall to the soil.

BEAUTY.

The rapid denudation of the surface of its timber is resulting seriously to the beauty of the State. The forests remaining have been stripped of the fine specimen of every specie for commerce till only fragmentary ragged forests remain. The over-abundance of fine trees in the past has been to the detriment of an ethical regard and esthetic admiration for trees. The same neglect is observable in this feature of beauty as along all other lines of forest influences.

Every land owner in the State should see to it, as his religious duty, to beautify his holdings with fine trees of the native varieties. The spirit of our Western States should be followed, and around the premises, along the lanes, roadsides and in the fence rows, should be cultivated and cherished fine trees of the "oak," "walnut," "ash," "elm," "hickory," "sugar," "linden" and other of the forest trees the most valuable and long-lived.

As the few "Redmen" of to-day are but relics reserved of the once numerous thousands that roamed the land at will, so are the forests remaining but scanty relics of the ancient woods.

The words of Susan Fenimore Cooper in "Rural Hours" should be food reflection in this:

"What a noble gift to man are the forests!

"What a debt of gratitude and admiration we owe for their utility!

"How pleasantly the shadows of the wood fall upon our heads when we turn from the glitter and turmoil of the world of man!

"The winds of Heaven seem to linger amid their balmy branches, and the sunshine falls like a blessing upon the green leaves;

"The wild breath of the forest, fragrant with bark and berry, fans the brow with grateful freshness;

"And the beautiful woodlight, neither garish nor gloomy, full of calm and peaceful influences, sheds repose over the spirit."

The best trees to plant, though not the fastest growers, are the following: "White," "red" and "winged" elms, "scarlet," "laurel," "red," "yellow," "chestnut," "white" and "burr" oaks, "white" and "green" ash, Buckeye, Chestnut, Mulberry, Flowering Dogwood, Service Berry, Norway and Sugar Maples, Lin and the various kinds of "evergreens."

RELATION OF FORESTS TO OUR FOOD FISHES.

MASON B. THOMAS.

The influence of forests upon the abundance and condition of the fish in our streams can not be questioned. The character and number of fish in a stream depends very largely on the constancy and character of its water, and as this is so directly connected with the size and location of our forests, it is easily recognized that a close relation exists between the two.

Early census reports and other records show that we derived from our food fishes not a little revenue and thus contributed something to the prosperity of many of our people. Many were engaged in fishing as a business, and depended upon its income for their sole support. This has almost entirely disappeared; fishing is not now an established industry and our streams no longer contain any considerable supply of food fishes. It is true that seining, dynamiting and other methods of illegal fishing and stream pollution are responsible for much of this, but the steady reduction of our streams and the uncertainty of their volume has been a much more potent factor in the decline. This uncertain and very irregular flow, due largely to the cutting away of forests at their headwaters, has made the pollution of streams much easier, because of their lack of volume, and motion sufficient to clear themselves, particularly during the summer season when the destruction of fish from pollution is most liable to occur.

The large amount of mud and the debris washed into the streams from unprotected fields and barren hillsides has made much of our water unfit for the homes of fish or for their breeding. Suitable places for spawning are not as abundant as formerly and when one is found and the eggs deposited, the danger from their destruction by freshets, bringing debris and pollution that remains as a menace at low water, is very great.

Many large streams that once contained fish are now dried up and only the barren beds remain to indicate the conditions of former years. Were the remedies suggested for the restoration of our streams as waterways for our commerce inaugurated, in time we could again depend upon them for an important contribution to our revenue and our State's prosperity.

PLANTING WASTE LANDS.

In many sections of the State are areas of waste land, some large and others small, hilly, broken, swampy or otherwise valueless to the owners, except as they may afford some grazing. These areas if planted in timber suited to their character of soil and moisture and given the proper care, could be made to yield remunerative returns equal to the better grade lands. The time consideration for the crop's maturing could not be counted as a factor against, but one favorable to planting these areas, because if left as they are, all of time will bring nothing from them.

A reference to the table of soil adaptations of Indiana trees will disclose the fact that many good, valuable species of trees may be successfully cultivated on these waste areas. It may be more difficult to plant and cultivate, but consider what it is and give it the best effort. If the soil can not be plowed, use the next best means to get the trees into the soil and started to growing, and continue the cultivation as best you can.

Such a course of conduct will add not only to the income, but a beauty effect to such localities. Corporations could find a good investment in such lands, and if shown that they may be successfully planted in timber they will be sought. The time is now at hand when an area of young growing timber will be reckoned as a valuable consideration in real estate dealings the same as farm improvements. Many places of damaging erosion may be checked by planting trees. The roots will hold and bind the soil till a sod may be formed. It is by this feature of trees that irrigation reservoirs are hoped to be made a success in the mountainous, arid and erosive regions of the West and reclaim them for cultivation and production.

PLANTING FOR COMMERCE AND PROTECTION.

The planting of the best species of our native merchantable trees for this double purpose ought to receive attention by farmers and fruit growers. The planting of waste lands in timber will receive the kindest consideration because it is the best use that can be made of them, but the planting of the best agricultural land in

timber would give better returns in proportion as one soil area is better than the other, not taking into cognizance the protective feature to the fruit orchard and premises.

The Oaks, Ash, Elms, Walnuts, Hickories, Pines and Sugars are the most valuable kinds to plant for commercial purposes and will at the same time perform the function of a storm and winter brake. Most of these species are good medium rapid growth when well planted and cultivated. If planted at the regular distance apart for tree planting, valuable cuttings may be made at from 12 to 15 years in performing the necessary thinning of the crop.

This thinning will need to take place generally in periods of every five years and ought to yield a good income from each thinning. Thinnings should be made only at such times and to such extent as will insure the best form development and by the shading of trunks compel natural trimming.

A good scale to be governed by is the following: At planting there should be—2,722 trees to the acre, at the 12th year—1,360, at the 20th year—680, at the 30th year—420, at the 40th year—340, and at the 50th year—250 trees to an acre for a permanent forest. This does not correspond with wild forests, but for planted cultivated forests is a successful and first-class gauge.

There is no satisfactory data to state just what might be realized per acre from such an effort, but from the prices given for such material in bolt form, insures an income beyond what could be made by continued agriculture for the same term of years. Areas of timber planted and realized show net proceeds per acre ranging from \$3 to \$19.54 annually for every year while cultivated in timber. These reports are from poor or waste lands and in hampered regions and only indicate what might be realized from good lands, and under favorable market facilities.

FENCE POSTS AND RAILROAD TIES.

The quality and quantity of timber which now remains and the rapid removal of timber everywhere are signs of some economic problems which farmers and railroad companies will have to meet before many years for post and tie material. A majority of farms are now far short of suitable material for these purposes.

The growing tendencies are toward the smaller acreage of farms and more systematic fences, and an increase in the mileage of railroads. These tendencies mean a much greater demand for the above kind of timber product.

The successful farmer will meet these demands intelligently by producing on his farm such of this as he can, and will find by calculation that a large profit may easily be made in doing it.

Every farmer can set aside a part of his land to cultivate in Hardy Catalpa, Chestnut, Kentucky Coffeetree, Black Locust and Russian Mulberry and wait eight or ten years for his returns if such returns will pay him a larger average annual income for every year at less labor than a smaller return at more labor and certainty by cultivating crops annually.

These species of trees are the best known kinds for these purposes. They are the quickest growers, easiest propagated and are the most durable in contact with the soil. They may be grown on ordinary soil to the number of 2,000 or 2,700 trees to the acre very successfully, in either mixed or pure plantings. Hilly, sandy, gravelly and run down soils unsuited for grain cultivation is first class for this timber growing.

These trees rightly cultivated, will by reason of the time mentioned be suitable for posts, and at from twelve to fifteen years be large enough for ties. It would be a poor result not yielding more than two of either posts or ties per tree, which by calculation will reveal the income. Two years of cultivation and the harvesting is all that is necessary by way of labor and the expense of money need be but little.

The Hardy Catalpa is the best tree to grow in several respects. It grows well on any sandy, gravelly, bottom, level soil, but does not do well on steep hillsides or clay. It does well in a climate of not less than twenty-five inches of rainfall or where there is an underflow of water within ten or twelve feet of the surface.

The Catalpa is propagated best from seedlings grown in the same soil and climate as the area to be planted. Planters of this tree may gather the seed pods in the fall and keep them in a cool room till spring, when they may be sown in the nursery and transplant the seedlings the following spring in their permanent places. The seeds may be purchased very reasonable per pound, containing

about 20,000 seeds, of any seed or nursery company. Seedlings can also be purchased reasonable.

To get the best results from the Catalpa it should be cut back to within four or five inches of the ground at the end of the second year's growth in the fall after being transplanted. The following spring sprouts will put out from this stump. Late in the same summer all the sprouts, except one of the most thrifty to each stump, should be removed. This sprout by careful cultivation will form a long trunk instead of the branching tree as would otherwise result if not so treated, and unless so treated not half the amount will be obtained in crop output and quality.

The Black Locust grows well on the same soils as the Catalpa, and it does well on the hill slopes of the same soils, but does no good in hard wet clays. The "locust" should be trimmed carefully for the first two or three years to form clean long trunks, and keep in good growing condition. When so cultivated it is seldom ever attacked by borers.

The Locust is best propagated from seedlings which may be secured or grown the same as for "catalpa," except the treatment for the seeds before storing in the nursery is different, which will be found by referring to instructions for storing and handling seeds.

The Locust sprouts from the stump and for this reason does not need to be transplanted when a crop has been removed. The second crop by thinning is grown much sooner than the first because of the extensive root system of the stumps. A fair degree of caution will prevent the spread of this tree to other areas as is often said of it. This tree is next to the Catalpa in rank for posts and ties. It is very durable in contact with the soil.

The Chestnut grows best in retentive clay containing some sand. It does not demand rich soil and does well in sunny dry situations. The Chestnut is very durable in contact with the soil, hence is very highly prized for posts, ties and telegraph poles. It readily reproduces by sprouting from the stumps and the trunks are tall, tapering and free from branches when planted thickly. It is not as rapid a grower as the other two mentioned, but each successive rotation of crop is matured quicker than the preceding because of the extended root system of the stumps. The Chestnut may be grown from seeds or seedlings as desired and either are easily obtained as indicated for the others.

The Kentucky Coffeetree grows best in rich bottom soils, but does fairly well in sandy, gravelly soils if rich. The wood is very durable in contact with the soil. The trunk is tall, uniform and free from branching when planted closely. This tree is best grown from seedlings raised in the nursery. Do not attempt to grow direct in the permanent places from seeds. Seeds and seedlings are easily secured.

The Russian Mulberry does well on very sandy loam or dense clay soils. It is well suited to uplands, valleys and arid regions. Its wood is very durable in contact with the soil. Owing to its branching tendency the trunk is only suited for ties and posts. So great is its tendency to branch that it must be crowded close together and kept well trimmed in order to secure any length of trunk. It is not a rapid grower like the Catalpa and the Locust but proves very satisfactory considering its adaptation to soils. It is best produced from seedlings.

CAUTION.

All post timber should be cut during the winter, as when cut in full sap, fungus rot will destroy the lasting qualities of the wood in contact with the soil.

TIMBER CULTIVATION.

COPPICE.

Coppice, thickets of second growth, is a most satisfactory tract to cultivate for good results. When the heavy timber has been cut off the ground, especially if the cutting is done during the fall and winter, and the surface exposed to the sun, the dormant seeds grow and the stumps put forth sprouts. A dense thicket of the best thrifty young trees soon covers the tract.

At odd times and liberal effort, a systematic grubbing and thinning out should be given this growth. Remove the sprouts from the stumps, except one or two of the thriftiest, best formed and best varieties to the stump. Grub up the seedlings, leaving only the best kinds and varieties at the most convenient distances apart. The thinning should be such as will leave a thick growth, sufficient to shade the ground easily and keep down the weeds, briars and grass at four or five years.

Such a tract of well-mixed growth, having a sprout or seedling every six or eight feet apart, will in a period of eight or ten years prove the value of such an effort. The time to begin this work is when the growth has reached a height of twelve or fifteen feet.

HEAVY TIMBER.

In very few sections of Indiana may heavy first-growth timber now be found, and the best possible effort should be made for its care. Owners of such tracts should use only the down, dead, inferior and unthrifty trees in so far as they will suffice. Care should be exercised not to injure the growing timber in removing the inferior crop. A mistake is often made by cutting all the time from one side or edge of the woods instead of cutting from the entire tract and thus keep the tract uniform.

A motto for this kind of cultivation should be for farm use: first, remove all down timber; second, cut out the diseased and dying; third, take out the knotty, scrubby trees; fourth, use those that seem to be growing the least; fifth, for fence material and other uses requiring the best quality of timber, select the trees from the locations where they can best be spared and with the least injury to the generalness of the forest.

Brush and other rubbish should never be burned in a forest. No fire of any sort should be allowed, as a very little heat from fire will be the means of a tree's dying very soon, or result in an injured tree.

Limbs and tops that have been broken by storms should be cut out and the dead parts removed entire.

SHADE TREES.

The shade tree is a matter that is receiving much attention now by people of both the cities and country. There is a general awakening to the error which has been made in shade-tree planting the past few years.

The Carolina poplar has been the most generally recommended and planted tree for ornament and shade. As a result of this the cities and country are full of this pest as a shade tree, having no quality to recommend it beyond a rapid determined grower. It is

the climax of vice in tree life, and to rid the country of them for shade and ornament should be the aim instead of their perpetuation, except in regions where nothing else will grow. Cities having interested park boards are passing ordinances against planting them as well as other less valued kinds.

In shade-tree planting, as in the best business, the motto, "Whatever is worth doing is worth doing well," should be followed closely. If there is any meaning in the phrase, "A thing of beauty is a joy forever," it ought to be applicable to the shade trees which adorn the cities and country.

The cultivation of shade trees is a perplexing problem in cities under the present expansive improvement spirit. In many cities, trees are dying by the hundreds every year, and many are grubbed out or otherwise destroyed in street improvement. This latter destruction in most cases is unavoidable, but in the former much can be done to evade future losses. The great cause, undoubtedly, for so many trees dying every year is the manner of treatment they receive in the street improvement. In most cases the roots are destroyed almost to the stump of the tree in excavating for the streets and sidewalks. On each side of the tree is placed a thick wall of concrete filling which shuts out the water from the roots and is too hard to allow the roots a penetration in search of water. The rain is quickly conducted by the paved street into sewers and the trees must go unfed, except the small amount which accidentally gets to the roots or is gathered by the foliage.

Most of the shade trees now found that have been standing a long time are Soft Maple. The roots of this tree are not penetrative, but surface growing. This tree naturally demands much moisture, hence, under the above conditions can not live. The ways to avoid the wholesale death of shade trees in the future is to plant the more penetrating root kinds and avoid that plan of street improvement which places a fortress against moisture on each side of the tree and demands the sacrifice of the roots to do it. For these reasons it is better to have walks next to the street so that one side of the tree's roots are left unharmed to go out in search of moisture. The trees should also be well watered by hand frequently. This can easily be done by leaving a basin cavity at the base of the tree and by means of a hose, or otherwise fill it with water and let it soak into the ground around the tree. In

Germany, where are found the finest specimens of shade trees, the entire surface is paved around the trees, but the root system is untouched near the tree. Every year the pavement is removed for a ditch a few yards from the trunk and the ditch filled with barrels of water and the trees are fed for five or six days, when the pavement is replaced and left till the next annual feeding. Their trees are the result of two or three hundred years' work, but they have the realization of the phrase given above.

If shade trees become injured, they should be treated in the same manner as recommended for other timber culture. Every controllable thing that will injure a tree, as, removing the bark by allowing horses to gnaw them, carving, swinging from the limbs, or swinging around small trees, burning leaves or rubbish near them, pruning too close or pruning during the hot summer months, should be prohibited.

A tree is a thing of nature's plan and too much tampering with has bad results. The finest of ornamental and shade trees are found in those places where they have been allowed to grow and shape themselves as nature directed the work. Many trees now found adorning the older parts of cities are full of defective, rotten places, the result of excessive, out-of-season trimming. Such trees are at the mercy of storms and extreme conditions of every sort. Some topping and trimming is surely necessary but not the continued excessive cutting that is now too prevalent. A tree is a living organism and must be treated so in its care. The trimming should never be more excessive than the clipping of stray, crowding branches and sapping sprouts. Topping of excessively sky-seeking trees is also necessary, but in many cases, nature would correct the tendency, when the purpose had been reached and time would show a much finer tree than all the art of man's ingenuity.

WOODS PASTURE.

The woods pasture is a very difficult tract to cultivate successfully, but a very pleasing sight when properly taken care of. The ordinary woods pasture is an example of opposing forces. Forest trees grow best with shade, moisture and forest humus. The woods pasture has, instead of the forest humus, a dense sod, and

instead of shade is open to the sun's rays. These conditions modify the moisture relations found in the forest.

The few trees remaining can not long withstand these opposing conditions together with the tramping of the roots by stock. They may, however, be made to hold out for some time by proper cultivation. Excessive tramping of stock should be prohibited first, and when parts become injured or die they should be cut out. A tree with an entire dead top may be truncated and in a few years a thrifty growth be established. Trees so treated, if the cutting is done so as to remove all the dead wood and leave a perfectly live exposure for healing over, will form large, thrifty, spreading tops and withstand storms and exposure. The topping should be done so as to avoid splitting either the bark or wood, as these give opportunity for weather-rot. The cut should be made smooth and daubed with tar or paint. The topping and trimming should be done in the fall or early spring as soon as life will reveal all the dead and injured parts so they may be completely removed when once begun.

If the woods pasture is to be replanted, the sod should be broken the fall before planting and proceeded with in the same manner as given for general tree planting. Trees planted in the sod do no good.

TREE TRANSPLANTING.

A tree should be transplanted at a time when it is liable to the least injury. This period for broad-leaf trees is when the vital functions are dormant. A very good way, and one practiced by nurserymen is that of running a tree digger along under the rows of seedlings in the fall and cutting off the longest roots without exposing them to the dry atmosphere, and let the trees stand in the rows till the time to plant in the spring. This method is a good one if followed in a region of fine winter climate, but for Indiana conditions a better practice is to dig the trees in the fall at the end of the season's growth and heel them in for the winter in a well-drained pit where freezing is not too severe. They may be cared for equally well by placing them in the cellar and keeping dirt moistened over the roots. Either of these methods allow the cut roots to callous over before planting and are much surer to grow

than trees taken up, packed, shipped and transplanted within a few weeks.

Spring planting is much the better, as the freezing weather of winter frequently kills the young trees, due to the fact that frozen roots can not supply moisture to the stem as fast as it is needed by the twigs to balance absorption by the winds. This danger is avoided by a tree planted in the spring which gets a root hold established in the soil before winter. For these reasons farmers should grow their own nursery stock to have it on hand.

When a tree is removed from the ground for transplanting, its roots should be immediately plunged into a vessel containing a mixture of clay and water slush, which is a most essential requisite to successful tree planting. If the trees are to be transported a long distance the trees should be dipped in clear water instead of a puddle and packed carefully for shipment.

The best method for shipping trees is to wrap their roots in wet sphagnum moss, taking care to fill every cavity with the moss. Hay or straw are not good packing stuffs, but may be placed between the twigs to prevent bruising. After packing has been completed, heavy burlap should be sewed around the bundle leaving the tops protrude. The bundles should then be boxed and shipped by the nearest and quickest route.

As soon as trees are received, they should be hurriedly unpacked, dipped into the puddle and heeled in. The trench for heeling should be deep enough to bury the roots and trunks of the trees. Extend the trench east and west and the south bank should slope at an angle of about 30 degrees. Place the trees in the ditch in single layers, with the tops to the south and cover each layer with the fresh earth, leaving only the branching tops exposed. Leave the trees heeled in till the weather is favorable for transplanting, which is as soon as freezing is over, and the soil will bear to be put in good condition.

Setting the tree is the final act in a long series of movements and should be performed as if everything depended on it. See that the excavations are large enough to admit the roots without cramping or having to cut away the fibers, as on them depends the best results to the trees. Pack the soil carefully and firmly about the roots and set the tree a few inches deeper than it originally grew. A cloudy, moist day, with a still atmosphere, is best suited to do

this work. The aim of all this routine is to prevent injury to the roots and trunks of the trees by breaking or chaffing the bark. The reasons in many cases for the death of a tree, after a summer or two of growth, or of the rough, unhealthy condition and final heart-rot, is due to some injury during the preparation for and planting. A mistake that is made in tree planting is that trees are planted too far apart to insure protection against sun and evaporation. Trees are planted to-day, generally, at the same distances and in the same manner and given the same care as were the customs when the country was poorly drained, well forested and had greater rainfall. Trees demand moisture and shade for proper growth. Thick planting insures shade against the hot rays of the sun and prevents evaporation of the moisture by the sun and wind. It will be found better to plant trees thickly and thin out as growth demands room, than to plant thinly against the changed climatic conditions now. The best results are obtained from planting the one-year-old seedlings, except in the case of evergreens, when two-year-old seedlings are preferable. A more frequent error is made in planting too large trees than too young.

The younger trees, besides being surer, in time outgrow the larger trees planted. They are much cheaper, as nurserymen price their trees by the foot in height. Each foot added, after its best size, is a detriment to the tree because increased size diminishes the chances for successful transplanting. If tree-growers and tree-planters will observe these facts a large per cent. of the failures now observable in plantings will be obviated. The soil between the rows should be kept free from grasses and weeds and the superficial layer two or three inches thick should be frequently stirred till the growth is large enough to shade the ground and prevent soil plagues.

Evergreens will be found more difficult to grow. They should be planted closer and if possible kept under partial shade the first year. No evergreen seedling, if allowed to dry out before planting, will grow. Hence, the greatest caution must be taken with them to keep them moist and thoroughly alive till planted and for the first year after planting.

The soil should be prepared for tree planting, where it can be, the same as for any agricultural crop. A dibble is the most convenient instrument in the hands of men for planting. The spacing

may be made by any convenient marking device, as in corn planting.

For large wholesale planting and speed a plow may be used to make deep furrows across the plat. This method gives mellow, fresh dirt thrown up on both sides. Three men can work to advantage if the nursery stock has been made ready. One man dips the tree in the puddle and hands to the second who sets it in its place and puts on enough dirt to hold it. The third man follows with a hoe, completing the planting.

The trees may be cultivated by plowing the same as corn for the few seasons they need it to keep the soil clean and stirred.

GROWING FOREST TREE SEEDLINGS.

In forest-tree planting, the raising of seedlings is a matter of good economy and results. Home growing of seedlings makes forest planting possible to every one, but the purchase of the stock for it would place it beyond the average farmer. The conditions in Indiana are the most favorable for the execution of this work. The State is naturally a forest-producing one and no part of it is so remote from a forested area at this time but that the seed may be gathered with the greatest convenience for all demands.

It is important in gathering seed to get them from the same region or a like climate as the one to be planted. Experiments show that seedlings grown from seeds of a different soil and climatic region than is intended being planted, do not do so well as those from the immediate region. It should be the rule, as far as can be, to get seeds from a region as rigorous in matters of drouth, heat and cold as those where the tree is to grow. In procuring seeds from dealers ever so careful, one can not make sure of this point.

Seeds should be gathered as soon as mature, which may be ascertained by referring to the table of forest trees. Those seeds as the "elm," "maple," etc., ripening in the spring have a brief vitality and should be sown at once, after it has ripened. Such seeds should not be planted deeply, a covering of one-quarter to three-quarters of an inch being sufficient.

The seeds ripening later in the season, as shown by table, retain their vitality longer and do not germinate until the following season, hence, require greater attention in order to insure their germination. Under favorable conditions the seed may be planted in the fall as soon as mature, but owing to climate and other uncertainties, it is better to plant in the spring.

That the seeds planted may be preserved in the best condition they should be stored through the winter by the process of stratification. This consists in burying the seeds as soon as mature and cured reasonably in sand or earth and allowed to remain till spring. The manner of doing this is to make an excavation eight or ten inches deep and as large as required on a well-drained site, and place in, alternately, layers of seed and sand till the space is filled. Over this put a layer of straw or chaff, two or three inches, and cover with soil five or six inches deep.

If no water is allowed to stand on them, the weather and freezing is the thing they need. Sometimes the seeds are placed in boxes in the same manner and then the box is buried.

In the early spring the seed should be lifted out and immediately planted, for if left to dry the germ will die. It is usually best to plant the seed of the Oak, Walnut, Hickory and similar trees in their permanent places rather than transplant, as center-tap root trees are more difficult to transplant.

The storage treatment of seeds insures them against the results of low per cent. of germination that is characteristic of so many forest seeds. When the seeds are taken out of storage, all that are alive will show it and those that are not will be black and dead.

Those of the late ripening which do not need storage in the ground (see table) should be soaked for a time in warm water, before planting in the spring. The harder stone seeds need soaking for several hours. Under no circumstances allow the seeds to dry before planting.

Plant the seeds in drill rows, thickly and for hoe cultivation, eighteen inches apart, but for horse cultivation, three or three and one-half feet apart. The common tendency is to cover seeds too deep. No seed should be covered more than twice as deep as it is thick and the soil packed on them. Keep the nursery free from weeds and grass and the soil well cultivated around the seedlings.

In selecting the nursery site, choose a well-drained, loamy soil, not excessively rich, for overgrown rate seedlings do not do well when transplanted, but good average garden soil is the best. The soil should be plowed in the fall before planting and thoroughly pulverized just before planting in the spring.

Proper attention to the nursery will insure the best seedlings for planting at the end of the first year's growth and the best results will be found from planting the one-year-old seedlings.

The trees best to gather from, both for good seed and convenience, are those growing along roadsides, fences and open woods-pastures. Never gather from the early or late fallings, but from the middle maturing. The middle aged is also the best to select your seed from. Do not cut a tree for the seed. That method would not be the best one for the spirit of forestry. Shake down the seeds and let the tree stand.

FOREST TREE CUTTINGS.

A few of the forest trees may be grown best from cuttings. The growing of willows, poplars and cottonwoods, as well as some of the evergreens is thoroughly practical. The time to make the cuttings is any time between the sap's going down in the fall and its coming up in the spring. The particularly best time is February and March. The cuttings should be made from one and two-years-old growths of branches and ranging in size from one-quarter to one-half inch in diameter.

A convenient length for cuttings is eight to twelve inches. The cutting should be done with a fine, sharp instrument, so as not to split the wood. The cuttings should be tied in bundles of fifty to one hundred each, the large ends all tending the same way, and the bundles then buried to prevent their drying out. They should be buried at least ten or twelve inches deep, to prevent drying. Freezing will not hurt them.

Cuttings should be set in the spring, and the ground should be prepared same as for seed if can be. They should be set in the permanent places, the same distance apart as when planting the regular forest, four feet apart. They may be set straight or slanting, as is convenient and the earth firmly packed around them. Not more than two inches of the cutting should be left out of the ground after setting.

They should be cultivated well to keep weeds and grass down and the soil loose for growing. Where the soil can not be well plowed and pulverized a good method to set cuttings is to use a "dibble" in making openings in the ground. This instrument is handy, cheap and the best to use in such cases.

PREPARATION OF SEEDS FOR STORAGE.

When seeds have been collected, such as the "oaks," "hickories," "walnuts," "butternuts," "mulberries," "locusts," "coffee-tree," "cherries," "apples" and others, require special treatment to separate the seeds from the hulls and pulp. This consists in drying the cones, acorns and nuts; the pulpy pods, cherries, plums and berries, should be macerated till the seeds can be washed out.

When the cones of the "pines," "spruces," "hemlocks" and "cedars" have been well dried, the scales will open and liberate the seeds. The work may be hastened by whipping the cones about in a vessel which will let the seeds through. Many of the locust pods open and give up their seeds easily, when dried. The pulpy pods of the "honey-locust" and "kentucky coffee-tree" should be macerated and the seeds washed out. The same process will serve for the fruits. The thick walnuts should have the hull removed when gathered. The hulls can easily be removed by running them through a corn sheller or by bruising them on the ground with a maul and let them be for a time in the rain and sun, when the nuts can easily be separated from the hulls.

The hulls of the butternut and the overcups of many of the acorns need not be removed for storage, however; freezing will remove the cups from the acorns frequently.

When seeds have been divested they should be dried sufficiently to prevent moulding when stored, but care should be taken not to cure to the point of shrivelling or killing the germ. Fire heat should not be used if it can be avoided and at no time should the heat be above 70 degrees Fahrenheit. The drying should be done out of doors or in an airy room or loft.

When the seeds have been properly treated they may then be stored for the winter in the manner suited for them individually.

PROJECTED AND RECOMMENDED FORESTS.

1. Joseph Adams Estate, Thayer, Ind., Newton County, Lincoln Township.

Area of tract, 4,100 acres.

Area of timber projected, 800 acres.

Purpose—General.

Specie—Mixed.

Nature of land—Kankakee bottom.

Owner, Joseph Adams, Chicago, Ill., Union Stock Yards.

2. Estate of E. H. Hohman, Claypool, Ind., R. R. No. 1, Seward Township, Kosciusko County.

Area of tract, 40 acres.

Area of timber projected, 40 acres.

Purpose—Commerce.

Specie—Best mixed hardwoods.

Nature of Land.—Good agricultural.

3. "Garland Dells," or, "Shades," Waveland, Ind., Montgomery, County, Brown Township.

Area of tract, 200 acres.

Area in timber, 200 acres.

Purpose for which recommendation for cultivation was made—Jungle or Wild-wood Park.

Specie—General indigenous.

Nature of Land—Broken dells and rock cliffs, sand and clay ridges, ravines and bottoms.

Dr. Henry Moore, of Irvington, Ind., President of the Board of Control.

4. Many minor recommendations for farm utility and shade-tree planting have been made without official record.

FORESTRY AND THE STATE.

Forestry as a subject for the State to foster is beyond doubt. The issue is, to what extent shall the State act in the matter and keep within the bounds of its relation to the general people instead of the individual. Forestry is very general and far reaching in its effects. There can scarcely be found an institutional or intellectual

life which it does not affect directly or indirectly to a great or small extent with consistent reason. This fact has long ago been recognized by the enlightened nations of Europe and is now recognized by the United States and many of the individual States of the United States. Extended legislation, large appropriations prudently made and frugally expended, have added encouragement to forestry of both State and national character. The late report of forestry from the U. S. Department of Agriculture shows that the U. S. Department dealt with 11,026,000 acres the past year.

The short time the Indiana Forestry Board has been organized is not sufficient for conclusive evidence of results or to form a definite conclusion of the State's relations in the matter.

But enough has been found out to know that the present legislation is too meager to accomplish satisfactory consequences.

The work is hampered because of insufficient financial appropriation for office help and printing, to do field work and experiments necessary to put the subject fairly before the people. There is not sufficient legislation to secure forests against negligent wanton destruction or to compel a moral appreciation of them. The State has no reservations where forestry experiments and work may be made facts to the general people. Such reservations could supply the general people with material at a minimum sustaining cost for the further promotion of forests to rebound in their general effects.

These obstacles mentioned are for the consideration of every person interested in the general welfare. The State Board of Forestry is established by a law of the State and should give to the State value received for its creation. It can not do it so long as it is simply a creation devoid of the necessary means and help. If the department had these opportunities it believes it could give satisfactory returns. But until it does have them it appeals to the people to study well the subject and the extent to which the State should act, and take hold of forestry because it is for the general good and let the matter be so well understood that future legislation will be by common consent apparent and just.

STATE FORESTRY LEGISLATION.

AN ACT to establish a State Board of Forestry, defining its powers and duties, and creating the office of State Forester and secretary of said board, and fixing the amount of his salary and allowance for expenses.

[H. 192. Approved March 1, 1901.]

Section 1. Be it enacted by the General Assembly of the State of Indiana, That a board is hereby created and established, which shall be known under the name of the State Board of Forestry. It shall consist of five members who shall be appointed by the Governor, as follows: One from the membership of the Retail Lumber Dealers' Association of Indiana, one from the faculty of Purdue University, one from the woodworkers of the State, who is a mechanic actively employed at his trade, and one who shall have special knowledge of the theory and art of forest preservation and timber culture, and technical knowledge of the topography of the State, and said last described member shall, upon his appointment and qualification, become and be the secretary of said board and ex-officio State Forester. All of said members of said board shall hold their offices for four years and all except said Secretary and State Forester shall serve without compensation. A majority of said board shall constitute a quorum, and said board shall annually elect from its own number a president.

Sec. 2. Before entering upon the discharge of their duties, the members of said board shall each take and subscribe an oath of office before the Clerk of the Supreme Court that they will faithfully and honestly discharge the duties of said offices, which oath of office shall be filed in the office of the Secretary of State.

Sec. 3. The board shall meet at least once each quarter in the city of Indianapolis and as often as they may deem necessary upon five days' notice, signed by the president and secretary, and in the absence of the president, a chairman shall be chosen to preside. The minutes of all meetings shall be recorded by the secretary in a book to be kept for that purpose.

Sec. 4. It shall be the duty of said board to collect, digest and classify information respecting forests, timber lands, forest preser-

vation and timber culture, and to recommend plans and methods for forest preservation and timber culture and for the establishment of State forest reserves. The board shall, annually, on or before the first day of December, file with the Governor a report.

Sec. 5. The secretary of the board shall keep his office at Indianapolis, in a room to be furnished said board by the custodian of the State House, and shall perform such duties as are prescribed by this act or may be required by the board and he shall, as far as practicable, submit to the associations and meetings of timber dealers, woodworkers, farmers, and engineers of maintenance of way of railroads, information and facts as to forests and timber.

Sec. 6. The secretary and (State Forester) shall receive an annual salary of twelve hundred dollars and allowance for expenses of his office and his traveling expenses not exceeding six hundred dollars. Said secretary shall give his exclusive time and attention to said office and shall not hold any other office, appointment or position other than herein provided for. The president of the board shall quarterly certify the amount due the secretary upon vouchers duly attested by the secretary before some officer authorized to administer oaths, and the amount so certified shall be paid to the secretary out of the treasury of the State upon warrant of the Auditor of the State.

Sec. 7. Whereas an emergency exists for the immediate taking effect of this act the same shall therefore be in force and effect from and after its passage.

FOREST RESERVATION.

[Act Approved March 8, 1899.]

Section 1. Be it enacted by the General Assembly of the State of Indiana, That upon any tract of land in the State of Indiana, there may be selected by the owner, or owners, as a permanent forest reservation, a portion not to exceed one-eighth of the total area of said tract, which shall be appraised for taxation at one dollar per acre.

Sec. 2. If such selection is an original forest, containing not less than 170 trees in each acre, it shall become subject to this act upon filing with the auditor of the county in which it is situated, a description of such selection as is hereinafter provided.

Sec. 3. If any land owner shall plant not less than 170 trees on each acre of selected forest reservation, and shall cultivate and maintain the same for three years, then it shall become subject to this act, as herein provided.

Sec. 4. Upon any tract selected as a forest reservation which contains 100 or more original forest trees on each acre, the owner may plant a sufficient number of forest trees which shall make up the required 170 trees per acre, when the same shall become subject to this act, as in Section 3.

Sec. 5. No land owner shall receive the benefit of this act who shall permit cattle, horses, sheep or goats to pasture upon such reservation until said trees are four inches in diameter.

Sec. 6. Whenever any tree or trees shall be removed or die, the owner, in order to avail himself of this act, shall plant other trees in place of such trees as may be removed or die, and protect such trees until they are four inches in diameter; shall plant others which shall at all times maintain the full number required by this act.

Sec. 7. Not more than one-fifth of the full number of trees in any forest reservation shall be removed in any one year, excepting that such trees as may die naturally may be removed, when other trees shall be planted.

Sec. 8. Ash, maple, pine, oak, hickory, basswood, elm, black locust, honey locust, Kentucky coffee-tree, chestnut, walnut, butternut, larch, tulip tree, mulberry, osage orange, sassafras and catalpa shall be considered forest trees within the meaning of this act.

Sec. 9. It shall be the duty of the auditor in every county to keep a record of all forest reservations as the same shall be filed with him, and he shall require the owner or agent to subscribe under oath the extent and description of land reserved, and that the number of trees is as required by this act, and that he will maintain the same according to the intent of this enactment.

Sec. 10. It shall be the duty of the assessor to personally examine the various forest reservations when the real estate is appraised, and to note upon his return the conditions of the trees, in order that the intent of this act may be complied with. And if the reservation is properly planted and continuously cared for, he shall appraise the same at one dollar per acre.

THE HISTORY AND GROWTH OF FORESTRY.

One has only to go back in history in order to find a time when the greater portion of the globe was covered with forest in one shape or another. What uses has been made of this primeval forest is a subject of study full of interest.

Before man could gain dominion over the beasts of the field, as by the power given him, he had first to form his fields by clearing off this natural forest. From the time long before the psalmist sang that "A man was famous according as he lifted axes upon the thick trees," to the present, this activity of forest destruction has continued, with exceptions in ancient times when kings intercepted and afforested for the purposes of hunting and gaming, and in modern times when nations took legal enactment to afforest and preserve the timber lands for reasons of utility.

The different purposes for which this primeval forest has been used are of the most interesting investigation. During the early historic period of Europe, when the legions of Rome were waging their wars against the Britons, Britain was densely wooded. Caesar describes the Britons as being a true forest people because they made use of the forests in hampering his lines of march with felled trees.

During the Saxon and Danish periods, the forests were looked to and protected as the source of the food supply, by reason of their game. Under later Saxon rule, the clearing and enclosing of land for cultivation began. The result of this operation, to the game, caused the discontinuance of further clearing and enclosing.

As early as the period of the Heptarchy, the royal appropriation of large tracts of forests began. The first regular statute, relating to forests in England, was granted by a parliament held at Winchester, 1016, A. D., and was a Norman forgery.

Forest offenses were punished savagely under this rule. In 690, A. D., forests were protected by King Ine's laws for the purposes of hunting, fuel, building material and the pannage of pigs. Before the end of the seventh century the value of a tree was estimated by the number of swine that could find shelter under it.

Heavy fines were imposed upon any one for burning or destroying any tree bearing fruit which pigs ate, and a forest was described as one of so many pigs in taking its value. Not even brushwood was allowed cut in these royal forests, and a long line of watchers and keepers, mounted and armed, administered justice and ruled subordinates.

William the Conqueror's work in afforesting the "New Forest," in 1079, was a highly colored piece of work, in which he destroyed thirty-six parish churches, together with the houses and townships and made habitations for wild beasts. The afforesting of 17,000 acres from 1042-1066 shows how much interest the rulers of England manifested in the subject.

Henry I, during his rule, disafforested much of the royal forests in compliance to his people. This was continued through the unsettled times of Henry and Stephen. Henry II, however, restored the old laws and exacted large fines from the destroyers. King John went to the extreme and banded the nobles against him when he afforested all of Essex and Cornwall.

This banding of the nobles, resulting in the grant of the Magna Charter, in 1215, repealed the cruel forest laws, and by 1225, a universal disafforestation had begun. This disafforestation continued into the modern period.

In 1843, during the reign of Edward IV, an act was passed authorizing the cutting of forests for seven years. This gave a great impulse to the destruction of woodlands. The destruction authorized by Edward continued till 1504, when James IV, seeing that the forests of Scotland were almost completely destroyed, enacted a law against the felling or burning of greenwood without permission and made such an offense punishable with a fine of five pounds. This act also compelled every owner to plant one acre of wood on his estate, if it had no forest on it.

By 1523 a systematic forestry had been started in England. In that year John Fitzherbert wrote his "Book of Husbandry," which treated of the cultivation of trees and general work of forestry, and contained an appeal to the young men of England to educate in the subject. England and eastern European nations have kept up vigilantly the spirit of afforesting, began in the sixteenth century, and find that they can afford vast outlays in money and land, and justly enact extravagant legislation to right the

wrong done in Edward Fourth's reign, but up to now it can not be said that a finally settled policy exists in any of the States, not even in Germany, only a highly advanced stage with the tending of increased governmental activity.

England, in the home country, has but 2 per cent. of the 3,000,000 acres of woodlands under state control. This may be accounted for by fact of her insular position and typography. But in India there is a well-organized forestry administration of 60,000 square miles reserved and 34,590 square miles protected by the government. Schools in both England and India supply technical education to offices.

Italy is probably behind any of the other nations in government control. It has but 1,856 acres under state control, the remaining 7,000,000 acres belong to communities, corporations and individuals. But Italy has lately enacted extreme laws for afforesting 534,000 acres at a cost of \$12,000,000.

Germany, the model of forestry management, has as State property 11,360,000 acres; managed by State authority, but owned by corporations, villages and towns, 2,212,000 acres; under strict government control, where all permissions must be obtained from the government, 3,875,000 acres; under state inspection as special property, 4,767,000 acres.

France, next in rank to Germany in systematic management, has in its five sections 16,880,390 acres. It is interesting to note the exact detail to which the forest laws of these two nations apply in every phase of forestry. This is easily accounted for from the fact that they have been working at it for nearly three centuries.

It is equally interesting to note that the returns to the States are large in fostering home industries and in revenue. England's net income from her forests is \$3,714,000 or 44 per cent. of gross income annually, Germany's greater, and that of France some less.

Russia, one of the largest forest area nations of the world, has 600,000,000 acres under government control. Russia profited by the experiences of her sister nations and made no mistake. Russia has had laws from her early history, but the elaborate restriction laws date from the year 1888.

The growth of forestry in the United States does not show that history as it does in England. The sentiment of forest protection was strong among the early settlers because of their English experi-

ence. In Massachusetts repeated enactments were provided for the care of forests.

In Pennsylvania, the founder of the commonwealth made it a condition that on all land purchased from him that one acre out of every five should be left in forest. Other States also took action of the same or similar kind. In 1873 the real spirit of forestry began in the United States. At that time the American Association for Advancement of Science, held in August, at Portland, appointed a committee to memorialize Congress and the States upon the importance of promoting timber cultivation and preservation and recommending legislation.

The action of Congress in 1799 in purchasing timber suitable for the navy and augmented by enactments at different times from 1817 to 1831, and which resulted in the purchase and partial protection of 244,000 acres of forest in Florida, Alabama, Mississippi and Louisiana can not be regarded as anything but special legislation though it may have stimulated the forestry thought.

Immediately following the Civil War the great impetus of railroad building and the extension of the timber trade renewed the agitation for forest protection. In 1867, Wisconsin appointed a committee to report on the results of forest destruction and was followed two years later by Maine in a formulated policy for tree planting.

Between 1868 and 1878 laws were passed by nine western and two eastern States for planting trees. In 1878 Congress passed and amended the homestead law to settlers who planted one-fourth of their entries in specified kinds of trees. From 1872 to 1893 there were several enactments for providing land agents to overtake the depredations to the government lands and protect these lands.

In 1891 the timber culture laws were repealed, but in the repeal was a clause giving the President the power to set aside any part of the public lands, wholly or in part covered with timber, as public reservations, and declare the boundaries of such. The first reservation under this clause was 18,000,000 acres, which called for the inauguration of a national forest policy from the Secretary of the Interior in 1896.

In compliance with the Secretary of the Interior, and on the part of the Academy of Science, a committee of seven, of whom

six were from the distinguished members of the Academy, and one a professional forester, on the part of the government, were chosen. With the exception of an appropriation of \$25,000 for traveling expenses, this committee served without pay.

At the recommendation of this committee the President proclaimed eleven reservations, aggregating 21,000,000 acres, February 22, 1897.

Considerable agitation was precipitated by a misunderstanding of the purposes of this law, caused by no explanation being given out to the public by either the President or the committee. By 1898, the people accorded in the work and the appropriation for care and preservation of national forests amounting to \$175,000 was voted by Congress.

The President increased the previous reservations 6,708,425 acres in 1900. The management and workings of forestry in the United States has been in the Department of Agriculture, but this last year finds it formed into a division separate, with a good appropriation to sustain it.

Many States have exercise in forest matters directly or indirectly: California, Colorado, Indiana, Kansas, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio and Pennsylvania.

In other States are private organizations looking after private interests. It surely is but a question of time when the United States will have a finely systematized forestry of both State and national operation.

TOTAL LAND AREAS AND EXEMPTIONS, 1901.

<i>Counties.</i>	<i>No. of Acres in Exemptions.</i>	<i>No. of Forest Exemptions.</i>
Adams	121	9
Allen	320	4
Bartholomew .....	...	..
Blackford	75	2
Benton .....	...	..
Boone	2	1
Brown (no report).....	...	..
Carroll	369	29
Cass	2,026	90
Clark .....	...	..
Clay .....	...	..
Clinton .....	...	..
Crawford (no report).....	...	..
Daviess .....	...	..
Dearborn .....	...	..
Decatur	120	9
Dekalb .....	...	..
Delaware (no report).....	...	..
Dubois .....	...	..
Elkhart .....	...	..
Fayette (no report).....	...	..
Floyd (no report).....	...	..
Fountain .....	...	..
Franklin .....	...	..
Fulton	85	8
Gibson (no report).....	...	..
Grant .....	...	..
Greene	315	7
Hamilton (no report).....	...	..
Hancock	57	4
Harrison .....	...	..
Hendricks .....	...	..
Henry	61	3
Howard (no report).....	...	..
Huntington	30	2
Jackson .....	...	..
Jasper	10	1
Jay .....	...	..
Jefferson .....	...	..
Jennings .....	...	..
Johnson (no report).....	...	..
Knox .....	...	..
Kosciusko	82	5
Lagrange	29	1
Lake .....	...	..
Laporte (no report).....	...	..

<i>Counties.</i>	<i>No. of Acres in Exemptions.</i>	<i>No. of Forest Exemptions.</i>
Lawrence
Madison
Marion
Miami (no report).....
Marshall
Martin
Monroe
Montgomery
Morgan
Newton (no report).....
Noble
Ohio
Orange
Owen	48	..
Parke
Perry	80	1
Pike
Porter (no report).....
Posey (no report).....
Pulaski	53	4
Putnam
Randolph (no report).....
Ripley
Rush
Scott
Shelby
Spencer
Starke (no report).....
Steuben	43	..
St. Joseph.....
Sullivan
Switzerland
Tippecanoe (no report).....
Tipton
Vanderburgh
Vermillion (no report).....
Vigo	195	..
Wabash	950	85
Warren	20	1
Warrick
Washington
Wayne
Wells	40	2
White (no report).....
Whitley
Total	5,312	284

NUMBER OF MANUFACTORIES, OUTSIDE OF INCORPORATED TOWNS AND CITIES, USING WOOD FOR MANUFACTURE.

REPORTED BY TOWNSHIP TRUSTEES BY COUNTIES.

<i>Counties.</i>	<i>No. of Factories</i>
Adams	8
Allen	23
Bartholomew	14
Benton .....	..
Blackford .....	..
Boone	3
Brown	9
Carroll	8
Cass	7
Clark	6
Clay	3
Clinton	6
Crawford	3
Davies	5
Dearborn	6
Decatur	1
Dekalb	9
Delaware	10
Elkhart	2
Fayette .....	..
Floyd	2
Fountain	7
Franklin	11
Fulton	6
Gibson	21
Grant	4
Greene	5
Hamilton	3
Hancock	6
Harrison	15
Hendricks	9
Henry	9
Howard	2
Huntington	3
Jackson	18
Jasper .....	..
Jay	1
Jefferson	5
Jennings	12
Johnson	8
Knox .....	..
Kosciusko	9
Lagrange	9

<i>Counties.</i>	<i>No. of Factories.</i>
Lake	2
Laporte	2
Lawrence	6
Madison	3
Marion	3
Marshall	3
Martin	3
Miami	2
Monroe	11
Montgomery	5
Morgan	7
Newton .....	..
Noble	6
Ohio	4
Orange	8
Owen	4
Parke	4
Perry	9
Pike .....	..
Porter .....	..
Posey	6
Pulaski .....	..
Putnam	6
Randolph	4
Ripley	12
Rush	4
Scott	4
Shelby .....	..
Spencer	10
Starke .....	..
Steuben	5
St. Joseph	7
Sullivan	24
Switzerland	4
Tippecanoe	1
Tipton .....	..
Union .....	..
Vanderburgh .....	..
Vermillion .....	..
Vigo	5
Wabash	1
Warren	2
Warrick	2
Washington .....	..
Wayne	2
Wells	9
White .....	..
Whitley	5
Total	488

TOTAL LAND AREAS AND EXEMPTIONS, 1901.

<i>Counties.</i>	<i>No. of Acres in Farmland.</i>	<i>No. of Acres in Timber.</i>
Adams	188,645	13,280
Allen	357,482	29,876
Bartholomew	234,027	16,713
Benton	191,254	1,731
Blackford	83,070	3,767
Boone	225,259	3,654
Brown	133,813	24,826
Carroll	281,134	11,958
Cass	177,344	16,858
Clark	346,718	19,343
Clay	164,036	3,940
Clinton	347,392	2,428
Crawford	148,209	22,374
Daviess	213,410	16,938
Dearborn	139,472	13,821
Decatur	172,686	12,241
Dekalb	134,449	6,911
Delaware	202,524	7,884
Dubois	185,857	16,406
Elkhart	246,447	13,663
Fayette	123,237	6,180
Floyd	184,212	11,195
Fountain	198,226	8,796
Franklin	219,543	36,995
Fulton	193,693	6,950
Gibson	240,920	10,890
Grant	205,597	11,773
Greene	247,566	19,555
Hamilton	183,303	7,834
Hancock	161,501	9,253
Johnson	168,323	5,048
Knox	208,250	8,887
Kosciusko	282,702	24,052
Lagrange	179,890	10,579
Lake	190,957	4,253
Laporte	215,803	17,490
Lawrence	222,058	38,988
Madison	191,962	8,962
Marion	243,127	6,419
Marshall	222,228	11,177
Martin	169,232	36,094
Miami	196,781	24,833
Monroe	196,810	22,197
Montgomery	242,474	7,184
Morgan	224,150	15,396
Newton	419,996	11,604

<i>Counties.</i>	<i>No. of Acres in Furnland.</i>	<i>No. of Acres in Timber.</i>
Noble	234,559	13,134
Ohio	25,522	3,126
Orange	186,973	38,464
Owen	202,462	22,992
Parke	325,126	11,847
Perry	180,454	36,524
Pike	152,514	11,732
Porter	236,990	12,817
Posey	192,115	24,515
Pulaski	192,175	4,949
Putnam	238,379	17,882
Randolph	226,956	19,822
Ripley	234,084	27,079
Rush	189,209	8,204
Scott	133,164	7,175
Shelby	163,296	5,040
Spencer	200,465	21,169
Starke	106,232	15,784
Steuben	18,525	1,746
St. Joseph	258,555	9,463
Sullivan	226,265	9,716
Switzerland	18,002	965
Tippecanoe	262,626	5,374
Tipton	95,996	3,609
Union	99,709	6,722
Vanderburgh	197,965	14,041
Vermillion	130,610	3,907
Vigo	111,529	873
Wabash	229,167	13,705
Warren	199,396	3,772
Warrick	22,290	2,814
Washington	244,886	42,831
Wayne	252,357	7,718
Wells	215,360	22,842
White	254,963	7,008
Whitley	152,586	10,888
Total.....	18,266,964	1,227,141

PARTIAL LIST OF INDIANA TREES, HABITS, PROPAGATION, WOOD CHARACTERISTICS
AND USES.

COMMON NAME.	LATIN NAME.	SOIL ADAPTATION.	LOCATION IN STATE.	BEST GROWN FROM.
White Oak	<i>Quercus Alba</i>	Clay, sand upland	General	Acorns
Red Oak	<i>Quercus Rubra</i>	Moist, rich and porous	General	Acorns
Scarlet Oak	<i>Quercus Coccinea</i>	Low, rich, alluvial	General	Acorns
Pin Oak	<i>Quercus Palustris</i>	Low, rich, swamp	Southern	Acorns
Chestnut Oak	<i>Quercus Muhlenbergii</i>	General	Central	Acorns
Swamp White Oak	<i>Quercus Bicolor</i>	Low, wet, swamp	General	Acorns
Basket Oak	<i>Quercus Michauxii</i>	Low, wet, alluvial	Southwest	Acorns
Burr Oak	<i>Quercus Macrocarpa</i>	Low, well-drained	General	Acorns
Texan Red Oak	<i>Quercus Texana</i>	Moist, rich	Southeast	Acorns
Black Oak	<i>Quercus Velutina</i>	Uplands	General	Acorns
Spanish Oak	<i>Quercus Digitata</i>	Dry, gravelly	Southern	Acorns
Barren Oak	<i>Quercus Marylandica</i>	Dry, sandy	North	Acorns
Willow Oak	<i>Quercus Phellos</i>	Sandy	Southwest	Acorns
Shingle Oak	<i>Quercus Imbricaria</i>	General, rich	General	Acorns
Swamp Oak	<i>Quercus Lyrata</i>	Borders of swamps	Southwest	Acorns
Post Oak	<i>Quercus Minor</i>	Dry, sandy	Southwest	Acorns
Chinquapin Oak	<i>Quercus Acuminata</i>	Any rich soil	General	Acorns
White Elm	<i>Ulmus Americana</i>	General	General	Seedlings
Hickory Elm	<i>Ulmus Racemosa</i>	Rich, low, wet clay	Southeast	Seedlings
Red Elm	<i>Ulmus Fulva</i>	Rich, low, hillsides	General	Seedlings
Black Walnut	<i>Juglans Nigra</i>	Rich, alluvial	General	Nuts
White Walnut	<i>Juglans Cinerea</i>	Rich woodland	General	Nuts
Pecan	<i>Hicoria Pecan</i>	Bottom, alluvial	Southwest	Nuts
Swamp Hickory	<i>Hicoria Minima</i>	Wet and swamp	North	Nuts
Shellbark Hickory	<i>Hicoria Ovata</i>	Hickory sand ridges	General	Nuts
Shellbark Hickory	<i>Hicoria Laciniata</i>	Moist, rich, alluvial	General south	Nuts
White Heart Hickory	<i>Hicoria Alba</i>	Rich upland	South	Nuts

Smallfruited Hickory.....	Hicoria Microcarpa.....	Rich woodlands.....	Central, south.....	Nuts.
Pignut Hickory.....	Hicoria Glabra.....	Dry hills.....	General.....	Nuts.
Buckeye.....	Aesculus Glabra.....	Rich, low soil.....	General.....	Fruit.
Canoe Birch.....	Betula Papyrifera.....	Alluvial sand.....	Extreme north.....	Seedlings.
Red Birch.....	Betula Nigra.....	Low and wet.....	Southern.....	Seedlings.
Sweet Birch.....	Betula Lenta.....	Moist, alluvial.....	Local.....	Seedlings.
White Ash.....	Fraxinus Americana.....	Any rich soil.....	General.....	Seedlings.
Green Ash.....	Fraxinus Lanceolata.....	Low, rich bottom.....	Southern.....	Seedlings.
Blue Ash.....	Fraxinus Quadrangulata.....	Hills and ridges.....	General.....	Seedlings.
Black Ash.....	Fraxinus Nigra.....	General.....	General.....	Seedlings.
Yellow Poplar.....	Liriodendron Tulipifera.....	Rich	General.....	Seedlings, cuttings.
Linden.....	Tilia Americana	Rich	General.....	Seedlings.
Sugar Maple.....	Acer Saccharinum	Rich upland	General.....	Seedlings.
Black Sugar Maple.....	Acer Nigrum	Rich lowland	General.....	Seedlings.
Bed Maple.....	Acer Rubrum	Low, wet.....	General.....	Seedlings.
Black Locust.....	Robinia Pseudacacia	Rich, low, sandy	General.....	Seedlings.
Honey Locust.....	Gleditsia Triacanthos	Low, rich	General.....	Seedlings.
Wild Plum.....	Prunus Americana	Low, rich	General.....	Seed.
Wild Black Cherry.....	Prunus Serotina	Rich highland	General.....	Seedlings.
Persimmon.....	Diospyros Virginiana	Abandoned	Southern.....	Seedlings.
Flowering Dogwood.....	Cornus Florida	Rich upland	General.....	Seedlings.
Hardy Catalpa.....	Catalpa Speciosa	Rich, general	General.....	Seedlings.
Sassafras.....	Sassafras Officinale	Upland, clay	General.....	Seedlings.
Hackberry.....	Celtis Occidentalis	Upper river, dry	General.....	Seedlings.
Red Mulberry.....	Morus Rubra.....	Rich bottom	General.....	Seedlings.
Sycamore.....	Platanus Occidentalis	Wet, general	General.....	Seedlings.
Iron Wood.....	Ostrya Virginica	Dry, sandridges	General.....	Seedlings.
Chestnut.....	Castanea Sativa	Upland, rich	Southern.....	Nuts.
Beech.....	Fagus Americana.....	Rich upland	General.....	Nuts.
Cottonwood.....	Populus Deltoidea	Low wet	General.....	Seedlings.
White Pine.....	Pinus Strobus.....	General hilly	General.....	Seedlings.
Yellow Pine.....	Pinus Mius	Low swamp	Southern.....	Seedlings.
Bald Cypress.....	Taxodium Distichum	Swamps	Southwest.....	Seedlings.
Tamarack.....	Larix Americana	Swamps	North	Seedlings.
Red Cedar.....	Juniperus Virginiana.....	Hilly gravel	General.....	Seedlings.

PARTIAL LIST OF INDIANA TREES, HABITS, PROPAGATION, WOOD CHARACTERISTICS
AND USES—Continued.

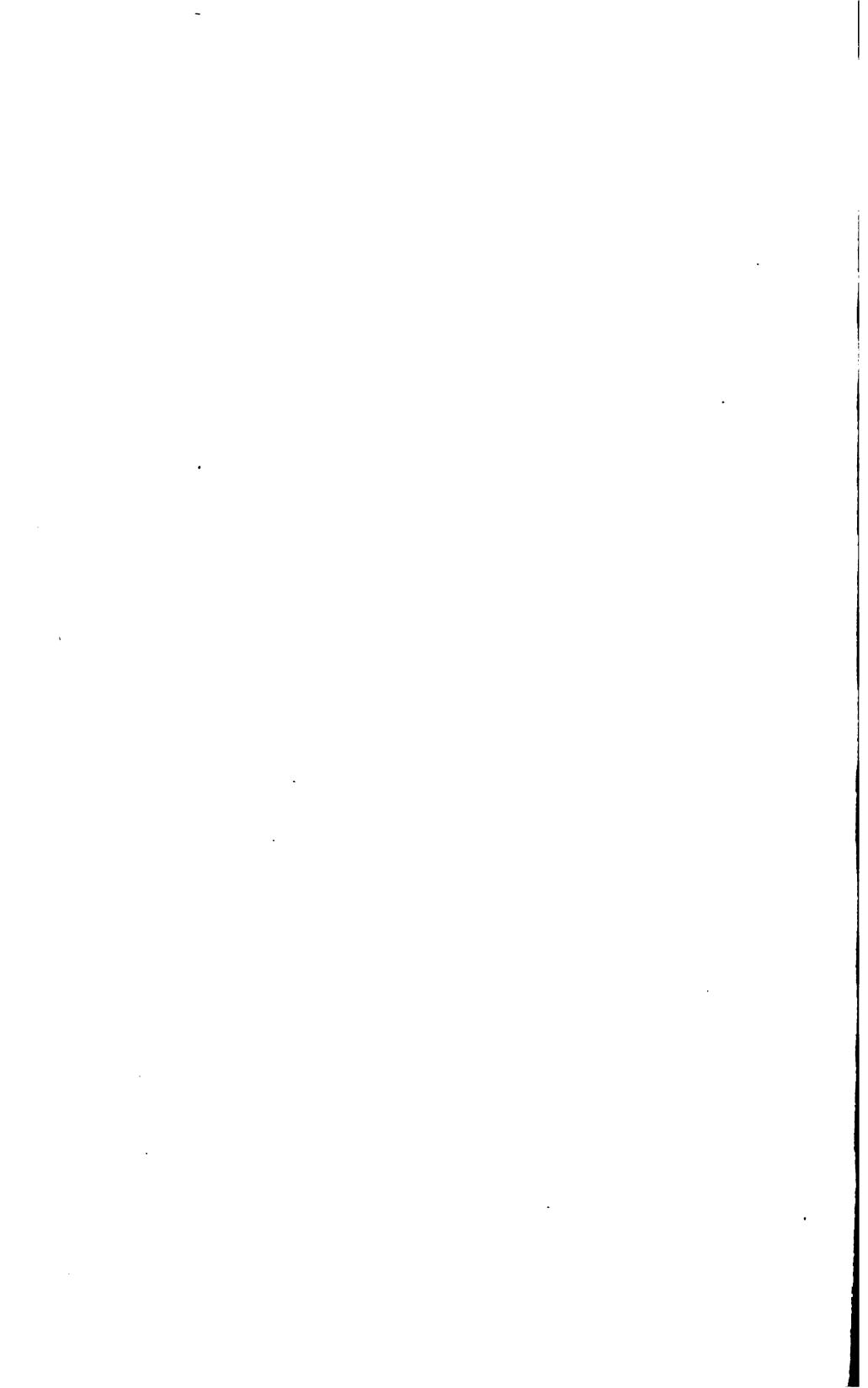
COMMON NAME.	SEED RIPENS.	SEED STORAGE.	TIME TO SOW.	GROWTH.	AVERAGE HEIGHT.
White Oak	September and October	Bury in sand	Spring or fall	Slow	80 feet
Red Oak	September and October	Bury in sand	Spring or fall	Medium	80 feet
Scarlet Oak	September and October	Bury in sand	Spring or fall	Medium	100 feet
Pin Oak	September and October	Bury in sand	Spring or fall	Medium	80 feet
Chestnut Oak	October and November	Bury in sand	Spring or fall	Medium	80 feet
Swamp White Oak	September and October	Bury in sand	Spring or fall	Slow	100 feet
Basket Oak	September and October	Bury in sand	Spring or fall	Slow	100 feet
Burr Oak	September and October	Bury in sand	Spring or fall	Medium	100 feet
Tern Red Oak	September and October	Bury in sand	Spring or fall	Medium	100 feet
Black Oak	September and October	Bury in sand	Spring or fall	Medium	80 feet
Spanish Oak	September and October	Bury in sand	Spring or fall	Medium	80 feet
Barren Oak	October and November	Bury in sand	Spring or fall	Slow	50 feet
Willow Oak	September and October	Bury in sand	Spring or fall	Slow	60 feet
Shingle Oak	September and October	Bury in sand	Spring or fall	Slow	60 feet
Swamp Oak	September and October	Bury in sand	Spring or fall	Medium	80 feet
Pot Oak	September and October	Bury in sand	Spring or fall	Slow	60 feet
Chinquapin Oak	October and November	Bury in sand	Spring or fall	Medium	80 feet
White Elm	May and June	No storage	At once	Medium	90 feet
Hickory Elm	May and June	No storage	At once	Medium	70 feet
Bed Elm	May and June	No storage	At once	Medium	50 feet
Black Walnut	October and November	Bury in sand	Spring or fall	Rapid	120 feet
White Walnut	October and November	Bury in sand	Spring or fall	Rapid	60 feet
Pecan	September and October	Bury in sand	Spring or fall	Medium	125 feet
Swamp Hickory	September and October	Bury in sand	Spring or fall	Medium	60 feet
Shellbark Hickory	September and October	Bury in sand	Spring or fall	Medium	130 feet
Shallbark Hickory	September and October	Bury in sand	Spring or fall	Medium	80 feet
White Heart Hickory	October and November	Bury in sand	Spring or fall	Medium	80 feet

Smallfruited Hickory	September and October	Bury in sand.....	Medium	Spring or fall
Pignut Hickory.....	October and November.....	Bury in sand.....	Medium	Spring or fall
Buckeye.....	September	Bury in sand.....	Medium	Spring or fall
Canoe Birch.....	September and October.....	Dry, cold	Medium	Slow
Red Birch.....	May and June.....	No storage.....	Slow	Spring or fall
Sweet Birch.....	September and October.....	Dry, cold	Slow	Spring or fall
White Ash.....	September and October.....	Bury in sand	Slow	Spring or fall
Green Ash.....	September and October.....	Bury in sand	Medium	Medium
Blue Ash.....	September and October.....	Bury in sand	Medium	Medium
Black Ash.....	September and October.....	Bury in sand	Medium	Medium
Yellow Poplar.....	September and October.....	Bury in sand	Medium	Medium
Linden.....	September and October.....	Bury in sand	Medium	Medium
Sugar Maple.....	September and October.....	Bury in sand	Slow	Slow
Black Sugar Maple.....	September and October.....	Bury in sand	Slow	Slow
Bed Maple.....	May and June	No storage	Slow	Slow
Black Locust.....	September and October.....	Bury in sand	Fast	Fast
Honey Locust.....	September and October.....	Bury in sand	Fast	Fast
Wild Plum.....	August and September.....	Dry and cold	Medium	Medium
Wild Black Cherry.....	August and September.....	Bury in sand	Medium	Medium
Persimmon.....	October and November.....	Bury in sand	Medium	Medium
Flowering Dogwood.....	October and November.....	Bury in sand	Slow	Slow
Hardy Catalpa.....	October and November.....	Cold and dry	Fast	Fast
Sassafras.....	August	Cold and dry	Medium	Medium
Hackberry.....	August and September.....	Bury in sand	Medium	Medium
Red Mulberry.....	July and August	Cold and dry	Medium	Medium
Sycamore.....	October and November.....	Bury in sand	Medium	Medium
Iron Wood	May and June	No storage	Slow	Slow
Chestnut.....	September and October.....	Bury in sand	Spring or fall	Spring or fall
Beech.....	October and November.....	Bury in sand	Slow	Slow
Cottonwood.....	June and July	Dry and cold	Fast	Fast
White Pine.....	August and September.....	Dry and cold	Medium	Medium
Yellow Pine.....	August and September.....	Dry and cold	Medium	Medium
Bald Cypress.....	September and October.....	Dry and cold	Slow	Slow
Tamarack.....	September	Dry and cold	Slow	Slow
Red Cedar.....	September	Dry and cold	Slow	Slow

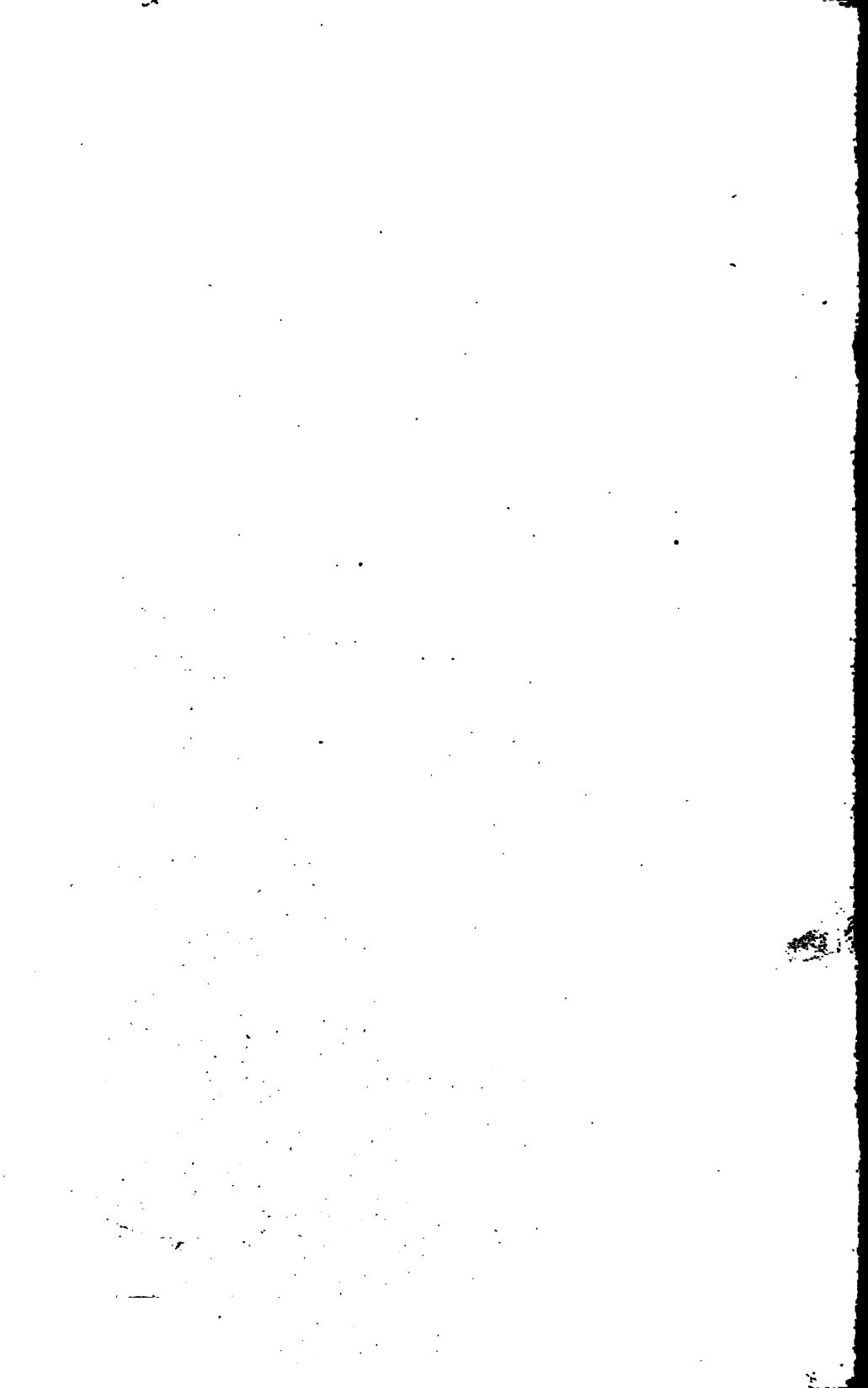
PARTIAL LIST OF INDIANA TREES, HABITS, PROPAGATION, WOOD CHARACTERISTICS
AND USES—Continued.

COMMON NAME.	WOOD CHARACTERISTICS.	SOIL CONTACT.	PREDOMINANT USES.	CURING PROPERTIES.
White Oak	Strong and tough	Good	Best general manufacturing and fencing	Good.
Red Oak	Coarse, hard and strong	Not good	Shingles, furniture, cooperage and finish	Good.
Scarlet Oak	Coarse, hard and strong	Not good	Shingles, furniture, cooperage and finish	Good.
Pin Oak	Coarse, hard and strong	Medium	Shingles, bridge, construction and cooperage	Good.
Chestnut Oak	Coarse, hard and strong	Good	Cooperage, wheelstock, ties and fencing	Bad.
Swamp White Oak	Coarse, tough and hard	Good	Good general manufacture and fencing	Good.
Basket Oak	Hard and strong	Good	Implements, wheelstock, cooperage and fencing	Good.
Burr Oak	Hard, strong and heavy	Good	Good general manufacture and fencing	Good.
Texan Red Oak	Hard, strong and heavy	Medium	Shingles, furniture and cooperage	Good.
Black Oak	Strong and heavy	Not good	Cooperage and building purposes	Bad.
Spanish Oak	Strong and heavy	Not good	Cooperage and building purposes	Bad.
Barren Oak	Strong and heavy	Not good	Fuel	Bad.
Willow Oak	Strong and heavy	Not good	Shingles, construction and wheelstock	Good.
Shingle Oak	Strong and heavy	Not good	Shingles and fuel	Bad.
Swamp Oak	Tough, heavy and hard	Good	Good general manufacture and fencing	Good.
Post Oak	Heavy and hard	Good	Posts, ties and cooperage	Medium.
Chinquapin Oak	Heavy, hard and strong	Good	Ties, cooperage, wheelstock and fencing	Good.
White Elm	Tough and strong	Bad	Wheelstock, shipbuilding, flooring and saddletrees	Good.
Hickory Elm	Hard, tough and strong	Good	Implements, ties and bridge construction	Good.
Red Elm	Closelygrained and strong	Good	Wheelstock, posts and ties	Good.
Black Walnut	Closelygrained and strong	Good	Cabinet, furniture veneer and fine finish	Good.
White Walnut	Light, soft and weak	Good	Cabinet, furniture and fine finish	Good.
Pecan	Heavy, hard and brittle	Bad	Wheelstock and fuel	Bad.
Swamp Hickory	Hard, strong and flexible	Medium	Implements, carriages, handles and baskets	Good.
Shellbark Hickory	Hard, strong and flexible	Medium	Implements, carriages, handles and baskets	Good.
White Heart Hickory	Hard, strong and flexible	Medium	Implements, carriages, handles and baskets	Good.
Smallfruited Hickory	Hard, strong and flexible	Medium	Implements, carriages, handles and baskets	Good.

Pignut Hickory	Hard, strong and flexible	Medium	Implement, carriages, handles and baskets
Buckeye	Light, tough and finegrained	Good.	Artificial limbs and paper pulp
Canoe Birch	Bad	Good.	Spools, shoeasias, pegs and pulp
Red Birch	Bad	Good.	Furniture and woodenware
Sweet Birch	Bad	Good.	Furniture, shipbuilding and distilling
White Ash	Hard, heavy and strong	Good.	Good general manufacture
Green Ash	Heavy and brittle	Good.	Inferior substitute for white ash
Blue Ash	Hard, heavy and brittle	Good.	Flooring, carriage and implements
Black Ash	Hard, heavy and brittle	Good.	Fine interior finish, cabinet, barrel hoops and basketis
Yellow Poplar	Light, soft and brittle	Good.	Fine interior finish, cabinet and building purposes
Linden	Light, soft and closegrained	Good.	Woodware, furniture, lath, pulp and charcoal
Sugar Maple	Hard, heavy and tough	Good.	Furniture, shoelaces, pegs, saddleirees, turnery, flooring
Black Sugar Maple	Hard, heavy and tough	Good.	Furniture, shoelaces, pegs, saddletrees, turnery, flooring
Red Maple	Hard, heavy and brittle	Good.	Furniture, woodenware, gunstocks
Black Locust	Dense and hard	Good.	Posts and wagon hubs
Honey Locust	Heavy and hard	Good.	Posts and wagon hubs
Wild Plum	Heavy, hard and strong	Good.	Tools handles
Wild Black Cherry	Heavy and hard	Good.	Cabinet and interior finish
Persimmon	Heavy and strong	Good.	Shuttleas and planetocks
Flowering Dogwood	Heavy and hard	Good.	Turnery, engravings, hubs and bearings
Hardy Catalpa	Light, weak	Good.	Posts and furniture
Sassafras	Light, weak	Good.	Posts, skiffs, yokes and cooperage
Hackberry	Heavy and weak	Medium.	Fencing and furniture
Red Mulberry	Tough and weak	Good.	Fencing, cooperage and shipbuilding
Sycamore	Heavy and weak	Bad	Tobacco boxes, yokes and furniture
Iron Wood	Heavy and strong	Good.	Posts, handles and levers
Chestnut	Light, soft and weak	Good.	Post, ties and furniture
Beech	Hard and strong	Good.	Furniture, lasts, handles and hames
Cottonwood	Light and soft	Bad	Boxes, pulp and fencing boards
White Pine	Light and soft	Bad	Building and general manufacturing
Yellow Pine	Heavy and weak	Good.	Building, general manufacturing and fencing
Bald Cypress	Light and soft	Good.	Building, posts, ties and cooperage
Tamarack	Heavy, hard and strong	Good.	Posts, ties and telegraph poles
Red Cedar	Heavy, hard and strong	Good.	Posts, ties, cabinet and lead pencils







For 15/5/3
V. 6272

BULLETIN No. 2. (C. IX. 107)

INDIANA STATE BOARD OF FORESTRY

*CONCERNING THE RELATION OF FORESTRY TO
FACTORY, RAILROAD AND MINE.*



W. H. FREEMAN, *Secretary.*

Indianapolis.

1902

INDIANAPOLIS:
WM. B. BURFORD, CONTRACTOR FOR STATE PRINTING AND BINDING.
1902.

MAY 18 1903

Indiana State Library

Indiana State Board of Forestry.

OFFICIAL MEMBERS, 1902.

F. C. CARSON, <i>President</i> ,	- - - - -	MICHIGAN CITY
ALBERT LIEBER,	- - - - -	INDIANAPOLIS
JOHN COCHRANE,	- - - - -	INDIANAPOLIS
STANLEY COULTER,	- - - - -	LAFAYETTE
W. H. FREEMAN, <i>Secretary</i> ,	- - - - -	WABASH

Office, Room 93 State House, Indianapolis.

To the People of Indiana:

As the work in forestry advances the more forcibly are seen the evils of the past forest destruction and the influences resulting therefrom. The operations of the Board, such as could be accomplished, under the limitations of meager financial appropriation and field for permanent forestry demonstration and inducement, are less definite and exhaustive for report than are satisfactory. The effort has been almost exclusively confined to the general agitation of the subject and theory before the public by means of the press, bulletin publication, personal correspondence, arguments before Farmers' Institutes and visits over the State. The constant purpose has been to inform the people concerning forestry that they may see that it should be vigorously supported because of the present and the future general welfares.

The past history of Indiana discloses no spirit of forestry. Timber of the best kinds and unlimited quantity was cleared from the soil that it might be devoted to agriculture without any thought that a reasonable portion should be preserved for the future requirements of such a great State. Fifty years ago timber which now is sought as though it were gold, was the least valued of any product. The log-heap and the stream were the means used most energetically to get rid of this very cumbersome obstacle to progress in agriculture and civilization. But now the opposite state of affairs exists, and it is now one of the most valued and needed products in the present industrial attainment. It is now an essential moving cause to the heightened industrial attitude of the State.

The present spirit for forestry conduct in Indiana is good for such limited information and so brief a time of commotion. It seems the intentions of the Board have been met successfully, and that the people in all parts of the State are awake to the necessity of forest preservation and propagation. The growth of public interest in forests during the past year is deserving of congratulation. This is not due alone to the work of the Board, but in a greater degree to the alertness and intelligence of the people of Indiana to all matters which directly concern them. The thing which mili-

tates against the perfection of this commendable spirit by executed forestry is the lack of definite information by completed experiment for guidance. The citizens of Indiana have the right to ask at the hands of the Board of Forestry definite information on all matters of forestry, as by the law which created the department, but it will be unjust to make such demands if proper means are not afforded the Board to enable it to acquire such information and to place the same before the public.

In view of these facts the Board appeals to the people of Indiana for a candid consideration of the plans herein contained and a merited support of the same for a better forestry legislation and provided opportunity for definite experimental forestry and diffusion of information.

We are indebted to the State Printing Board for the favors of stationery and printing which were allowed the past year from its funds.

INDIANA STATE BOARD OF FORESTRY,
W. H. FREEMAN, Secretary.





AN INDIANAPOLIS VENEER PLANT.

Indianapolis is the largest veneer center in the world. Almost the entire log material is imported from other states and countries because Indiana no longer possesses such timber in any quantity.

LETTER OF TRANSMITTAL.

INDIANAPOLIS, IND., December 1, 1902.

HON. WINFIELD T. DURBIN,
Governor of Indiana:

Sir—We have the honor to submit herewith, in accordance with legal requirement, the Second Annual Report of the activities of the Indiana State Board of Forestry for the past year, ending October 31, 1902, together with papers of recommendations for future forestry in the State as reviewed by the Board, and which, in its judgment, are imperative.

Yours respectfully,

F. C. CARSON, President.

W. H. FREEMAN, Secretary.

REPORT AND RECOMMENDATIONS.

FINANCIAL STATEMENT, NOVEMBER 1, 1901, TO OCTOBER 31, 1902.

Annual amount appropriated by the General Assembly for expenses	\$600 00
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EXPENDITURES.

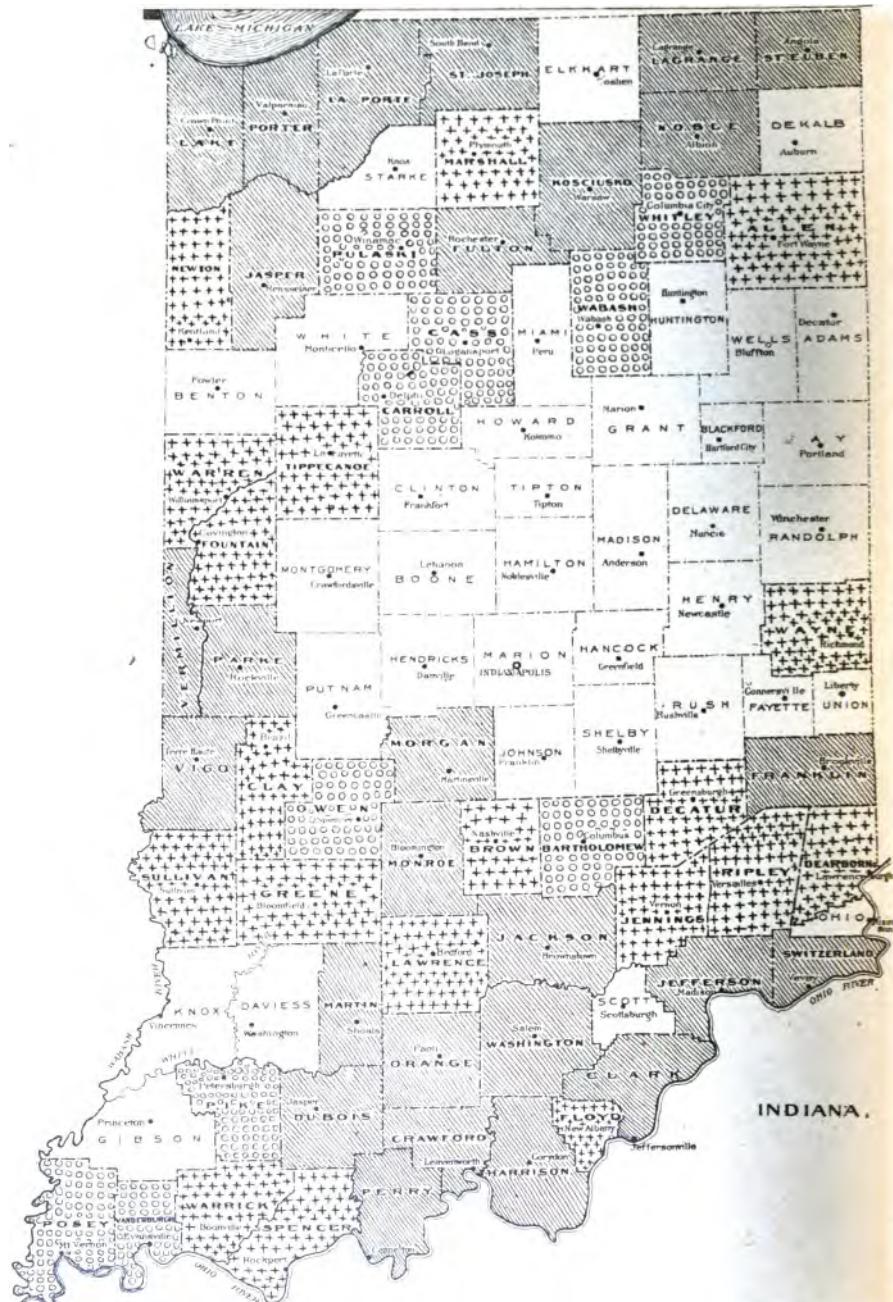
Overdrawn November 1, 1901.....	\$200 00
Office help, stenographer	221 83
Traveling expenses, mileage, livery.....	52 05
Office fixtures	59 50
Printing and stationery	8 87
Photographic supplies and photography.....	39 45
Books and periodicals	18 30
 <hr/>	
Total.....	\$600 00

Annual amount appropriated by the General Assem- bly for salary of Secretary of Board.....	\$1,200 00
Amount received by Secretary.....	1,200 00

SYNOPSIS OF WORK ACCOMPLISHED BY THE BOARD FROM JUNE 1, 1901, TO DECEMBER 1, 1902.

Inspected and rendered written plans for eleven forest tracts aggregating 2,357 acres; rendered written recommendations for fifty-three small economic plantings; visited and talked before fourteen farmers' institutes upon call; procured for office library 112 combined reports and publications on forestry and thirteen volumes standard works on forestry; formed for the distribution of forestry literature, to the people of the State, two mailing lists of 4,000 and 5,000 names, respectively, one for the United States Bureau of Forestry and one for the State Board's use; prepared matter for the publication of 5,000 copies of fifty-three-page bulletin on forestry, which was published by the State Printing Board, and matter for the publication of 13,000 copies of fifty-five-page illustrated Arbor and Bird Day Annual, which was published and mailed by the Superintendent of Public Instruction to the schools of the State; mailed from the office of the Secretary 4,950 personal letters, 2,300 circular statistical letters and 3,800 bulletins; the waste lands of the State have been visited and generally inspected as to their fitness for timber propagation.

MAP OF INDIANA, SHOWING COUNTIES POSSESSING GREATEST AREAS OF BROKEN, WASTE LAND.



Counties possessing 10,000 acres and more.



Counties possessing 7,000 acres and less than 10,000.



Counties possessing 5,000 acres and less than 7,000.



Counties possessing less than 5,000 acres.

INDIANA.



WASTE LAND.

*This view is a type of the denuded, broken, waste lands upon which the State is asked to demonstrate the profitable success of forestry. The natural reforestation of these lands show that they produce abundantly the best hardwoods. They should be cultivated to timber for the future demands of the industries.



INDIANA RAILROAD CONSTRUCTION.

*The railroads in Indiana use, annually, 12,500,000 ties, 750,000 fence posts and 600,000 telegraph poles. Plantations of catalpa, locust, chestnut and Kentucky coffeetree, for the future supply of these demands, on the waste lands, will prove valuable in from ten to fifteen years.



AN INDIANA HANDLE, SPOKE AND WHEEL-STOCK FACTORY.

This industry in Indiana uses, annually, of second growth timber 109,300 cords of ash and hickory bolts of 36 and 45 inch lengths and of 6 inches and upward in diameter; 1,300,600 oak and elm hub blocks; 59,440,000 feet of oak, ash and hickory dimension stuff.

The greater quantity is imported and difficult to secure.



AN INDIANA MINING PLANT.

The mines in Indiana use, annually, 1,893,750 props; 2,367,187 caps; 1,009,000 cross-ties; 5,400,000 rails; 77,312 cross-bars and 498,000 feet of shaft and brattis lumber. Miners find difficulty in supplying these demands. The abandoned coal lands will produce abundant timber.

RECOMMENDATIONS.

The foregoing report is not extensive because the small means at the Board's disposal was not sufficient to prosecute extensive investigations, and was therefore devoted to the agitation of the subject before the people of the State by means of the public press, lectures, visits and the preparation of material for such extended publications as could be secured through other departments of the State. The aim has been to disseminate information so as to have the small means affect the whole people in the State and thereby educate and stimulate an interest in forestry which would prepare the way for the perfection of a permanent plan for the State to foster when such a plan was determined, organized and presented.

While prosecuting this plan of agitation, the forestry situation and conditions in Indiana have been assiduously studied and investigated in order to determine the best plan for the State to assume for its future good. In suggesting the plan herein contained, the Board feels the deep sense of obligation it owes the State in recommending that project which is best for the State because only such measures will prove effective as are based on the exact needs of the State. The last General Assembly is to be congratulated for its actions in taking the first official steps in forestry. The law passed by that honorable body was wise in most respects. It placed the matter of forestry in the hands of an organized State Board with authority to regulate forestry conduct, but while small provisions were made for the execution of its plans, the limited means has prevented the inauguration of any radical measures which might have been instituted with less caution had ample means been afforded. But to secure to the citizens of Indiana the benefits which should come to them by reason of this forestry organization and the forestry conditions, such additional laws and provisions should be enacted as will enable the best degree of forestry prosecution within the State. In the light

of a deliberate judgment the Board suggests the following as a plan and an amendment to be acted upon by legislation at the coming session of the General Assembly of the State.

The plan proposed is that the General Assembly shall set aside a sum of money out of the general revenues of the State sufficient to purchase at least 2,000 acres of land in any county or counties of the State possessing cheap, broken, waste lands unsuited for good agriculture, and that the sum of \$1.50 per acre annually thereafter shall be provided from the general funds of the State to defray the expenses of conducting the land so purchased as a State forest reservation and laboratory of practical forestry demonstration in harmony with the industrial needs and forest conditions within the State.

The purchase of the land shall be by the State Board of Forestry and it shall have complete management of the same and it shall be superintended by the Secretary of the Board, who shall receive all the money derived from whatever source from such land and shall immediately pay the same into the State Treasury as a part of the revenues of the State, and the Secretary shall give his bond to the Governor of the State in the sum of five thousand dollars (\$5,000) for the faithful performance of his duty.

The land so purchased shall not exceed a cost of \$8 per acre and shall be taken in title in the name of the State of Indiana, and all moneys paid out shall be from the State Treasury upon warrant by the Auditor of State duly certified and attested by the President and Secretary of the Board.

It is proposed that section one (1) and section six (6) of an "Act to establish the State Board of Forestry, defining its powers and duties, and creating the office of State Forester and Secretary of the Board and fixing the amount of his salary and allowance for his expenses, H. 192, approved March 1, 1901, the same being sections 6628k and 6628p of Burns' Annotated Indiana Statutes, Revised 1901," be amended to have a representative from each, the Hardwood Lumber Dealers' Association of Indiana, and the actively engaged farmers of the State appointed members of the Board, and that provision be made to pay the members of the Board a per diem and traveling expenses for attending the necessary meetings of the Board. Also that larger funds be provided for the expenses of the office and Secretary for investigating and

prosecuting forestry work in the State along lines of working plans for propagation, methodic lumbering, forest measurements, forest fires, photography, forest inspection and the investigation of lands and soils in relation to the commercial trees.

As evidence to support the proposed plan and amendment the following facts should be considered: The population of the State by the census of 1900 is 2,516,462, or almost 70 per square mile. Of this number 151,799 are employed in the 2,413 manufacturing concerns and 14,576 in the 164 coal mines within the State. Of these manufacturing concerns 747 use wood as the primary raw material of manufacture and most of the others use it as the secondary raw material in their manufacture, while in the mines it is used in vast quantities in many necessary ways. The past great supply of the excellent hardwood timber which the State possessed has been a most potent factor in securing these manufacturing industries, and the timber supply must be sustained for the future if the majority of the concerns are to be retained.

The timber situation in the State now is as follows: First grade, heavy timber, 250,080 acres; second grade, second growth timber, 834,506 acres; third grade, thin woods pasture timber, 3,733,456 acres. Of the original 18,993,040 acres of dense forest which was unexcelled by any like extent of area in the United States, there remains only about one-seventy-fifth of the former acreage, and not to exceed one-sixteenth of the original acreage yet in forest possesses a timber value. These facts indicate that the State's timber resources are rapidly nearing the end. The original timber yet standing is in a state of decay, and but small effort is made at reforestation. The annual lumber commerce, as reported by dealers in the State, is as follows: Indiana product, 71,626,667 feet; Pacific product, 13,622,553 feet; Southern product, 162,960,316 feet; Northern product, 244,689,147 feet; number of fence posts, 611,280.

There is no data to show the vast quantity of timber used by the large implement and other factories which secure their material directly from the mills or the forest, but the following is submitted to partially indicate the enormous annual uses of wood in the State in addition to the above: Vehicle and handle manufacturing concerns use of ash bolts, 36 and 45 inches in length and from 6 inches diameter upward, of second growth stuff, 46,000 cubic

cords; of hickory bolts, same sizes and character, 63,300 cubic cords; ash dimension stuff, from older and larger timber, 9,280,000 feet; hickory dimension stuff, same character as the ash, 37,210,000 feet; oak dimension stuff and riven spokes, same character of timber as the ash and the hickory, 12,950,000 feet; oak blocks for wagon hubs, 688,000; elm blocks for hubs, 612,600. The railroads in the State use 12,500,000 ties, 750,000 fence posts and 600,000 telegraph poles, the cost of which is \$5,734,699. There is no data to show the amount of timber used in car and other construction by railroads. The mines in the State use timber, annually, as follows: Props, 6 inch face by 5 and 7 feet lengths, 1,893,750; caps, 6x18 inches, 2,367,187; cross ties, 3x5 inches by 5 feet lengths, 1,009,000; rails, 2x4 inches by 10 and 16 feet lengths, 5,400,000; cross bars, 6x6 inches by 9 feet lengths, 75,750, and 12x12 inches by 16 feet lengths, 1,562; shaft and brake lumber, 488,000 feet. The total cost of which is \$823,633.

With the above conditions at hand, it is no time for lamenting the past forest destruction or to hinder the industries which use timber. The things to do are to speedily inaugurate and promote the planting, the cultivating and the saving use of forests and encourage the industries that are so essential to the general welfare. Every situation demands that each acre within the State's boundaries be made to do its best. The good agricultural lands must and will be devoted to intensive annual farming and the waste, broken lands which are unfit for good farming should be cultivated to timber and made to produce the supply for the future needs of the State. The status of these lands for growing timber in masses for commercial and industrial purposes is par excellence. The aggregate of such lands in the State is, by recent statistics, 692,738 acres and is prominently in two sections of the State, the northern and southern, as is shown by the foregoing map of the State. These lands are distinctly of three classes; the hills of degradation in the south—level crested and narrow, others isolated peaks and buttes; long, narrow, curving strips covered with boulders in the more central part; sand and gravel plains, dunes, beach ridges, marshes and swamps in the north. Some of this land is submerged, but vastly the greater majority of it is not and grows, naturally, trees of both the hard and soft wood kinds, and under cultivation can be made to yield abundantly of the right

quality needed for the stable manufacture of both the products of the hard and soft woods, including paper pulp and mining uses.

The prime factors which are militating against the adoption of forestry upon these lands at this time are the lack of knowledge and information relative to the success of timber growing. The people are conscious of the scarcity of timber and the necessity therefor. Most of them are endeavoring to save their timber and would plant and cultivate if they were assured by practical demonstration that their efforts would be fruitful of satisfactory results. Suggestions are frequently made concerning the results, but it is not definitely known and the people desire the same assurance that they would ascertain before engaging in any business enterprise. Conditions in Indiana for growing timber are different from those in other states, and should therefore have demonstration within the State. The purposes also for which Indiana should demonstrate are somewhat different from those in other states and those of the United States. New York is engaged in forestry as a business for the purposes of purchasing and foresting the denuded areas, the protection of the streams, fish and game, and for state parks. Pennsylvania is in it as a business for the purchase and reforesting of the denuded land and mountain slopes as a means of assuring a future timber supply and to preserve the streams, prevent destructive erosion, modulate the climate, protect the game and fish and for state parks. The same may be said as to the purposes of the other states. The United States is engaged in forestry for the purposes of preserving the water supply and the irrigation of the lands in the arid regions of the West.

We are not inclined to the belief that Indiana should purchase a large number of acres of the waste land and engage in forestry as a business for making money. Whatever of finance there is in forestry belongs to the citizens of the State. If the State will demonstrate it as a good paying institution, there are plenty of people and capital to develop forestry on the waste lands as is being done in other states, of which the following are examples of both corporations and individuals:

The Sawyer & Austin Lumber Company has purchased 100,000 acres in Arkansas, which they are growing to pine as a recourse in the future lumber supply. The Deering Harvester Company has purchased 52,000 acres in Missouri and are propagating ash,

oak and hickory for the future supply of these needed timbers in its manufacture. The Great Northern Paper Company has procured 350,000 acres in Maine and is cultivating spruce, pine, fir and hardwoods for its future use. The Hon. Wm. C. Whitney is cultivating 1,600 acres in Massachusetts in hardwoods as a private estate. Hon. Wm. G. Rockefeller is cultivating 60,000 acres in the Adirondack region of New York to spruce, pine, poplar and hardwoods as an estate. Other private citizens of New York are following his example to the extent of 628,000 acres. The Okeetee Club of Ridgeland, S. C., is maintaining 60,000 acres as a laboratory for the study of long-leaf pine. These examples, though few, show the progress and trend of forestry, and no field is more favorable for investment in forestry than Indiana, and will therefore surely appeal to individuals, private and combined.

That the State would not be doing more than other states in the fostering of the plan and amendment proposed by the Board and enacting laws to sustain it, let the following facts concerning other states be considered: New York has now 1,408,181 acres of state reserves which has cost \$2,620,000, and appropriates annually \$223,796 for the expense of maintaining the same and pays its forester \$4,500 annually and necessary expenses. Pennsylvania has 500,000 acres in forest reserves at a cost of \$950,000, appropriates annually all the expense necessary to properly execute the plans, which cost, the past year, \$486,000, and pays its forester \$3,000 annual salary and \$2,500 contingent fund for his own private use. Michigan now has 47,000 acres in state reserves and is on the eve of making the greatest advancement in forestry of any state in the Union, and I am assured every contemplated project will carry at the next session of the Michigan Assembly. Minnesota appropriates \$11,000 annually for the firewarden alone. Connecticut appropriates annually \$2,000 with which to purchase land and \$2.50 per acre with which to cultivate the same. The United States possesses, in reserves, 58,850,925 acres and appropriates for entire expenses and control, \$300,000 annually.

By the present laws Indiana has no lands upon which the State Board can prosecute any permanent investigations, and appropriates but \$1,800 for the salary of the Secretary and every expense of office and investigation connected therewith. Forestry is not a thing of a short period, but surely must become a permanent

institution of the State and must be promoted by the present for succeeding generations.

Philanthropy is the spirit behind forestry and the industrial welfare is the motive that impels it. Forestry is one among the many good institutions established and maintained by the State which add stability to the State's industrial good and valued rank.

The expenditure which the plan and better equipment of the Board would entail will not reach the amount some may think. Lands of the character I am pleading to have planted and cultivated to timber can be secured for from \$3.00 to \$12.00 per acre. When it can be shown successfully that forestry is a paying institution upon these lands, they will be sought and the returns to the State will be in the taxable values which would accrue to the State in an almost endless series of connections.

In the light of the facts given, the plans proposed by the Board are modest, but it is confident that with such an amount of reservation disposed as a laboratory devoted to practical forestry in direct harmony with the industrial needs and land conditions within the State, sustained by an adequate financial equipment for the Board's investigation, that it can successfully demonstrate the claims made of forestry management. It does not seem wise at this time for the State to engage in forestry to a greater extent than the proper demonstration of the project and affording the means of informing the people of the State upon the subject. No one condemns the actions of the State in sustaining the State educational institutions and agricultural school and experimental stations, or denies the benefits that have been derived by the State by reason of the same, and therefore the Board appeals to the members of the coming General Assembly of the State and to the whole people represented by them to give the plans herein proposed an earnest, devoted consideration and support.

TOTAL FOREST LAND EXEMPTIONS BY COUNTIES IN THE STATE.

By B. F. JOHNSON, Statistician, 1902.

<i>Counties.</i>	<i>No. Forest Exemptions.</i>	<i>No. Acres in Exemptions.</i>
Adams	11	184.00
Allen	4	320.00
Bartholomew .....	.....	.....
Blackford	2	75.00
Benton	23	1,028.62
Boone	2	4.50
Brown .....	.....	.....
Carroll	35	436.50
Cass	132	2,865.00
Clark .....	.....	.....
Clay .....	.....	.....
Clinton	1	40.00
Crawford .....	.....	.....
Daviess .....	.....	.....
Dearborn	1	40.00
Decatur	10	142.50
Dekalb	2	120.00
Delaware .....	.....	.....
Dubois .....	.....	.....
Elkhart .....	.....	.....
Fayette .....	.....	.....
Floyd .....	.....	.....
Fountain .....	.....	.....
Franklin	5	171.00
Fulton	8	85.00
Gibson .....	.....	.....
Grant .....	.....	.....
Greene	17	535.00
Hamilton .....	.....	.....
Hancock	4	57.00
Harrison .....	.....	.....
Hendricks .....	.....	.....
Henry	3	57.00
Howard .....	.....	.....
Huntington	2	30.00
Jackson .....	.....	.....
Jasper	1	11.00
Jay .....	.....	.....
Jefferson .....	.....	.....
Jennings .....	.....	.....
Johnson .....	.....	.....
Knox	3	40.00
Kosciusko	5	82.00
Lagrange	1	40.00

<i>Counties.</i>	<i>No. Forest Exemptions.</i>	<i>No. Acres in Exemptions.</i>
Lake .....		.....
Laporte	9	273.00
Lawrence .....		.....
Madison	1	100.00
Marion .....		.....
Miami .....		.....
Marshall .....		.....
Martin	3	164.00
Monroe .....		.....
Montgomery .....		.....
Morgan	1	8.00
Newton .....		.....
Noble .....		.....
Ohio .....		.....
Orange .....		.....
Owen	2	88.00
Parke .....		.....
Perry	1	80.00
Pike	4	125.00
Porter	85	2,022.25
Posey	43	810.29
Pulaski	4	53.00
Putnam .....		.....
Randolph .....		.....
Ripley .....		.....
Rush	3	49.75
Scott .....		.....
Shelby	4	126.00
Spencer .....		.....
Starke .....		.....
Steuben	2	20.00
St. Joseph .....		.....
Sullivan	4	78.00
Switzerland .....		.....
Tippecanoe	3	26.00
Tipton .....		.....
Union	1	17.00
Vanderburgh .....		.....
Vermillion .....		.....
Vigo		195.00
Wabash	85	950.00
Warren	2	26.75
Warrick	1	9.00
Washington .....		.....
Wayne	1	10.00
Wells	2	40.00
White	64	1,424.72
Whitley .....		.....
Total	560	18,657.88

TIMBER AREAS, BROKEN, WASTE LAND AREAS AND NUMBER OF TREES PLANTED BY COUNTIES IN THE STATE.

Reported by B. F. JOHNSON, Statistician, 1902.

<i>Counties.</i>	<i>Acres of first grade timber.</i>	<i>Acres of second grade timber.</i>	<i>Acres of third grade timber.</i>	<i>Acres of broken waste land.</i>	<i>No. of trees planted in 1902.</i>
Adams	1,360	9,976	22,384	2,059	1,593
Allen	4,833	19,116	61,668	7,302	327
Bartholomew	2,849	8,628	32,994	7,307	761
Benton	315	195	2,188	4,011	....
Blackford	1,436	3,257	13,109	1,217	....
Boone	335	2,770	40,466	1,706	116
Brown	897	13,748	33,588	7,078	....
Carroll	4,311	9,317	21,788	5,672	1,301
Cass	4,744	14,837	20,875	5,774	15,006
Clark	1,538	11,431	36,232	17,327	8,888
Clay	1,191	7,692	24,381	7,945	3,059
Clinton	1,282	3,597	23,224	1,779	131
Crawford	1,115	9,356	37,812	14,676	140
Daviess	875	8,355	17,209	3,838	3,041
Dearborn	4,044	7,778	25,568	9,788	803
Decatur	1,691	3,587	25,220	7,002	772
Dekalb	1,674	10,816	31,434	3,799	162
Delaware	809	8,198	22,269	3,250	88
Dubois	17,214	21,821	41,685	11,182	....
Elkhart	3,122	11,963	18,965	3,926	529
Fayette	1,192	7,912	18,037	3,493	145
Floyd	760	5,190	14,330	7,052	53
Fountain	1,077	5,489	26,426	9,878	414
Franklin	3,367	15,033	56,880	12,516	95
Fulton	2,972	10,877	19,551	10,033	339
Gibson	3,563	6,034	19,543	2,519	1,788
Grant	1,866	7,803	24,036	2,013	820
Greene	8,846	17,423	31,385	8,316	88
Hamilton	4,745	3,718	20,787	1,735	1,045
Hancock	1,822	5,855	14,766	1,524	1,067
Harrison	4,123	24,706	47,555	20,379	623
Hendricks	1,682	20,055	44,437	1,481	58
Henry	20,022	10,786	21,535	1,383	11,555
Howard	5,787	6,341	13,583	1,651	228
Huntington	1,646	11,033	18,605	2,708	93
Jackson	2,777	12,280	48,940	14,279	392
Jasper	1,157	4,356	77,589	11,790	....
Jay	2,764	1,047	33,479	1,446	116
Jefferson	1,943	9,027	43,823	10,136	146
Jennings	1,351	8,516	43,452	8,067	21
Johnson	963	3,010	35,144	3,640	390
Knox	2,534	4,700	28,736	4,736	2,320
Kosciusko	3,599	12,282	36,152	13,115	410
Lagrange	3,157	13,008	16,221	13,491	93

<i>Counties.</i>	<i>Acres of first grade timber.</i>	<i>Acres of second grade timber.</i>	<i>Acres of third grade timber.</i>	<i>Acres of broken waste land.</i>	<i>No. of trees planted in 1902.</i>
Lake	506	9,181	22,868	11,090	80
Laporte	3,652	19,857	35,246	13,777	2,244
Lawrence	8,173	14,118	62,211	8,488	70
Madison	35,332	7,438	23,526	3,065	3,378
Marion	1,745	6,336	26,323	4,326	35,723
Marshall	1,694	14,761	32,375	8,079	174
Martin	3,715	15,855	27,366	11,315	27
Miami	4,269	9,953	27,117	4,448	3,042
Monroe	2,713	10,186	52,109	10,273	109
Montgomery	2,934	7,291	48,351	4,296	1,218
Morgan	4,951	12,995	40,141	12,243	3,209
Newton	3,033	535	28,925	8,978	145
Noble	3,425	16,114	13,358	17,840	477
Ohio	1,165	1,169	3,651	3,950	....
Orange	7,882	7,749	41,954	10,984	....
Owen	7,264	5,148	69,928	5,707	309
Parke	713	8,522	54,734	24,251	28
Perry	1,169	12,483	44,283	30,164	....
Pike	1,974	6,309	12,552	6,689	4,730
Posey	1,645	7,431	9,534	11,854	1,155
Porter	732	13,401	22,553	6,322	1,002
Pulaski	830	12,146	46,208	6,614	82
Putnam	1,153	6,451	84,300	3,263	210
Randolph	1,574	12,998	29,835	4,305	850
Ripley	7,374	12,389	40,079	9,875	1,434
Rush	3,030	4,734	28,931	2,763	847
Scott	445	6,809	17,336	2,371	600
Shelby	4,058	5,868	21,387	3,174	404
Spencer	5,361	25,358	20,767	9,218	352
Starke	3,277	4,242	37,011	4,726	....
Steuben	1,418	10,695	21,654	11,382	82
St. Joseph	4,528	11,776	24,908	13,519	905
Sullivan	2,536	3,609	26,833	8,963	1,185
Switzerland	4,724	3,180	19,160	10,055	105
Tippecanoe	3,088	7,652	19,697	7,512	1,760
Tipton	100	4,126	16,574	1,133	231
Union	498	1,876	19,952	2,620	....
Vanderburgh	4,374	1,996	9,642	6,653	13
Vermillion	321	1,950	18,532	11,311	114
Vigo	758	5,683	18,336	10,734	463
Wabash	2,692	10,786	27,315	5,240	3,069
Warren	1,031	4,184	20,510	7,856	6
Warrick	1,770	5,535	16,670	7,840	70
Washington	8,016	23,556	44,437	12,235	1,000
Wayne	8,050	6,585	32,080	7,920	515
Wells	470	9,870	21,263	2,042	3,750
White	519	10,999	29,273	2,128	748
Whitley	770	8,924	31,083	5,128	44
Total.....	250,080	834,506	2,753,456	692,738	123,675

Number planted by the public schools of the State, 1901-2, 31,736.

REGENERATING THE WOOD-LOT.

The farm wood-lot is properly receiving the earnest attention of foresters and farmers at this time. The first step which the people of Indiana should take in this matter of forest propagation is to regenerate the present forest areas that they may be made to supply the demands to their largest continued extent. A vast majority of the farms of any considerable area in this State, outside of those in the prairie sections, possess more or less timber land which is being retained as the wood-lot portion. A casual observation of these areas discloses the fact that the greater proportion of them are anything but valuable in timber resources. They possess but a limited variety of trees, and those of the least value in quality. The whole consists of a jungle of tops, logs, wild briars, thorn, hazel, water beech and other worthless underbrush. The best trees of every kind have been cut and all that remains are the culls of every condition. The areas are but fragments and blemishes, which are worthless for lumber and likewise valueless for fence material. Beyond the uses of scanty pasture and supply of fuel, they yield nothing to the owner. Instead of being estimated as values in farm sales, they are given no consideration of value, but on the contrary are deemed a detriment to the farm.

Such wood-lots do not pay for retention but they may be made valuable adjuncts to the farm, if regenerated. If a farm possesses ten or twenty acres of such area, it will be found more profitable to devote one-half of the area exclusively to forest, and regenerate and cultivate it systematically, and devote the other half to agricultural purposes. The half retained and systematically tended in timber, according to the plans given below, will not only produce more and better timber in after years than the whole area left in its former conditions, but will give an aesthetic and refined appearance to the farm; will provide an interesting and agreeable occupation to the owner and will add an important estimate to the sale value of the farm, because the time is at hand when a good growing

timber area on the farm will greatly enhance its value, the same as good fences, buildings and drainage.

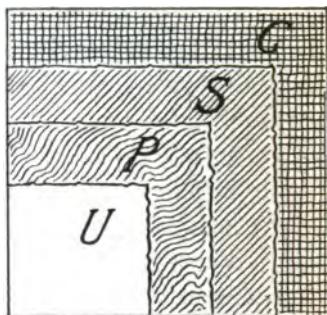
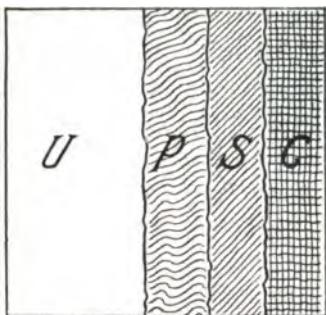
For some time past farmers have realized the scarcity of timber and the imperative necessity for conserving a portion of their woodland. To this end they have fenced off a portion that it might renew itself naturally with trees. Under favorable conditions as regards seed trees, shelter and humus soil, such a plan will be fruitful of fairly good results, but by securing the proper shelter, light, soil conditions, seeds and by grubbing out the worthless kinds which naturally spring up and choke out the valuable growth, the likelihood of gratifying and profitable results will be greatly increased.

The methods prescribed for cultivation and preparation will prove a vast saving in area and in increase of product in both quantity and quality, and the portion retained as a forest will be one in the full meaning of the term. If the regeneration is unaided by systematic sylviculture, the results will be tardy and the quality deficient. The process of regeneration employed should combine the natural and the artificial methods. There are various systems proposed for regenerating such areas of forest as have been described. The more favorable ones are the "strip" and "group" systems, as they most favorably meet the conditions existing within the State.

Under the "strip" plan, the regenerative process is conducted over strips instead of over the whole area to be cultivated. The strips are treated so as to have three receiving attention at the same time; one being in the completed stage, one in the stage of seeding, and one in the stage of preparation. The breadth of the strips is determined by the influences under which the owner is acting. The operations should be begun on the most permanent side and extended one after another till the whole tract is treated. In this manner the work will be well performed and different stages of timber will be growing.

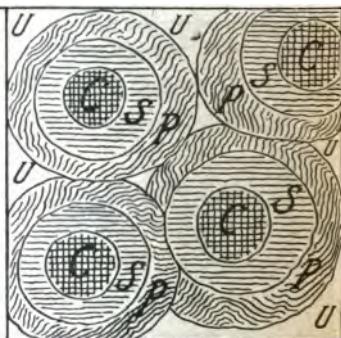
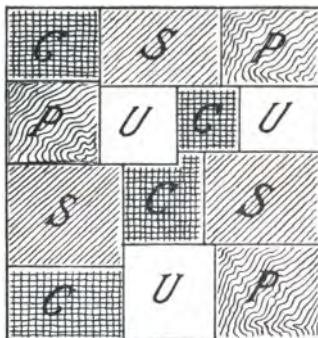
The "group" system may be viewed as a modification of the "strip" system. Under its workings, different patches are regenerated at intervals over the forest area and these are then enlarged by the same three stages of operations till they converge, and the whole area is thus regenerated. The main objection to this system is the unevenness of forest it produces. It is one of the most convenient means where good seed trees exist to spread out from them.

In almost every forest some good trees are standing which may be made nuclei for regenerating. It is a good plan where the varieties are desired in groups as opposed to a general mixture.



STRIP SYSTEM.

"c"—strip in completed stage, "s"—strip in seeding stage, "p"—strip in preparatory stage,
"u"—uncultivated area.



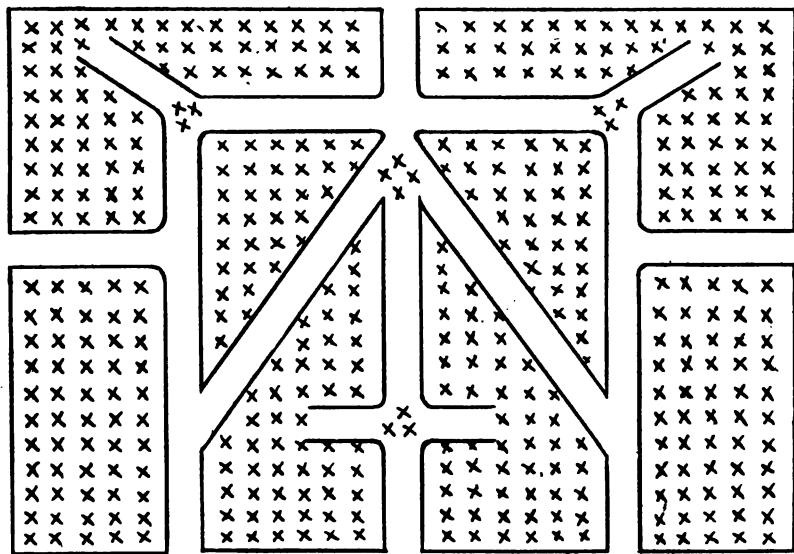
GROUP SYSTEM.

"c"—groups of completed area, "s"—groups of seeded area, "p"—groups of preparation area,
"u"—groups of uncultivated area.

Many considerations which should receive the most careful study enter into these regenerating processes. The porosity, moisture and humus are factors which the soil itself must possess in right relations. The climate and denseness desired are other important features. It may require much artificial assistance to get these relations in accord. In cases of too much humus and rubbish the same must be removed before the seed is sown. If the humus is deficient, the soil will have to be worked by such means as hoeing, plowing or harrowing. In cases of sod, the same course must be

pursued. If too much shelter exists, trees should be removed until the proper shelter and light are secured. Good conditions exist when enough shelter is obtained to prevent weed and sod growth and the soil is seen in half mixture with humus. When such conditions prevail, the seed will sink readily into the soil and the roots of the germinating seeds can penetrate for sustenance. It is advisable to at all times prepare the soil by working it.

The cutting of timber preparatory for this regeneration of forests consists in removing all the trees except such as are retained for seeding and to properly shade the ground. The successive cuttings will be determined in frequency by the size of the timber to be marketed or used. When once the forest has been regenerated so that trees for seeding properly may be retained over all parts of the tract, the idea in the "compartment" system can be executed

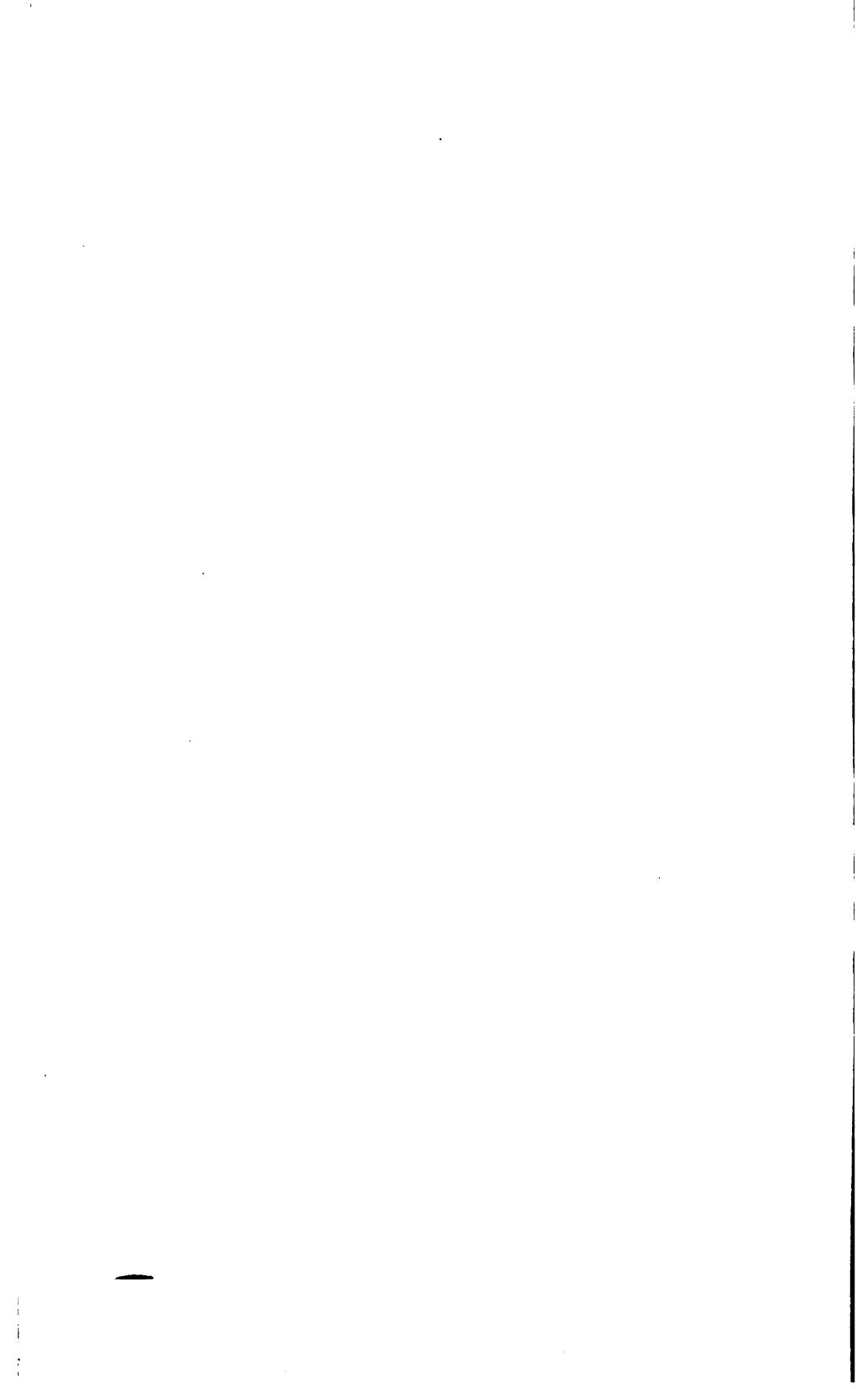


very well. By the "compartment" plan the whole area to be regenerated is seeded and cultivated in the same seed year, but it entails difficulties which only the most perfect conditions could obviate.

If the plans given are followed, and good seeds from the best varieties of valuable trees are secured and planted, the wood-lot will be all that is desired and the whole country will be more valuable and beautiful. Information concerning the gathering, prepar-

ing and planting of seeds may be found by referring to Bulletin No. 1 issued last year.

Caution: In regenerating the wood-lot, or in the planting of new areas, roadways should be left at intervals for getting into the forest for the removal of timber when desired. It will be found beneficial to do so. The sketch on preceding page may afford some idea of a plan:





BIRD'S-EYE VIEW OF THE RESERVATION FROM CUSTODIAN'S HEADQUARTERS ON GRAND VIEW KNOB.

STATE OF INDIANA

THIRD ANNUAL REPORT AND
DISCOURSES

OF THE

State Board of Forestry

1903

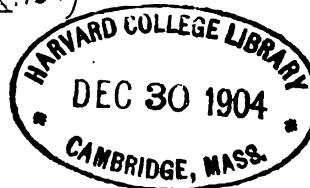
W. H. Freeman, Secretary

TO THE
GOVERNOR OF INDIANA

INDIANAPOLIS:

WM. B. BURFORD, CONTRACTOR FOR STATE PRINTING AND BINDING.
1904.

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(C IX.107)



Indiana State Library.

STATE OF INDIANA,
EXECUTIVE DEPARTMENT,
INDIANAPOLIS, December 20, 1903. }

Received by the Governor, examined and referred to the Auditor of State for verification of the financial statement.

OFFICE OF AUDITOR OF STATE,
INDIANAPOLIS, January 5, 1904. }

The within report, so far as the same relates to moneys drawn from the State Treasury, has been examined and found correct.

D. E. SHERRICK,
Auditor of State.

January 5, 1904.

Returned by the Auditor of State, with above certificate, and transmitted to Secretary of State for publication, upon the order of the Board of Commissioners of Public Printing and Binding.

GEO. B. LOCKWOOD,
Private Secretary.

Filed in the office of the Secretary of State of the State of Indiana, January 5, 1904.

DANIEL E. STORMS,
Secretary of State.

Received the within report and delivered to the printer this 5th day of January, 1904.

THOS. J. CARTER,
Clerk Printing Bureau.

INDIANA STATE BOARD OF FORESTRY.

OFFICIAL MEMBERS, 1903.

F. C. CARSON, President	Michigan City.
STANLEY COULTER	Lafayette.
ALBERT LIEBER	Indianapolis.
JOHN COCHRANE	Indianapolis.
W. H. FREEMAN, Secretary	Wabash.

Office of Secretary,
Room 93, State House, Indianapolis.

STATE OF INDIANA, BOARD OF FORESTRY.

Indianapolis, Ind., December 1, 1903.

Hon. Winfield T. Durbin, Governor:

Dear Sir—In accordance with the law by which the State Board of Forestry was organized, we have the honor to submit herewith the manuscript of the Third Annual Report of the work accomplished the past year and discourses concerning forest cultivation as in the judgment of the Board seems imperative and for the instruction of the people of the State.

Yours respectfully,

F. C. CARSON, President.

W. H. FREEMAN, Secretary.

INTRODUCTORY.

The past history of Indiana's forests is one not surpassed in excellence by that of any other State. At a time, about one hundred years ago, when the pioneers crossed the western boundary of the Eastern civilization, and, guided only by the familiar blaze of the surveyor's axe, wended their ways along the streams into the dense forests of oak, ash, sycamore, hickory, walnut, poplar, cherry, maple, elm, lin, beech and other deciduous trees, then covering the Northwest Territory, in search of future homes, no portion was more densely wooded than the territory of Indiana. At the beginning of the struggle for possession of the Wabash Valley by the English, the entire area of the now State of Indiana was covered with dense forests, broken only by the rivers, lakes and a few small prairie regions. But from the time these sturdy pioneers entered the territory and established themselves in the log cabin homes, the forests, tree by tree, have gradually yielded to the woodman's axe and vanished by means of the log heap and the stream to make way for fertile fields of harvest and busy cities of thriving industries and social swirl and the general advance of civilization until the present time finds the almost complete absence of virgin forest within the State's boundaries and a general timber scarcity menacing the stability of many manufacturing industries to the State and embarrassing the economic demands.

As the past history of Indiana's forests is not excelled by that of any other State, so it is with the present interest and advance of forestry in the State and by the State. For the brief time, two and a half years, forestry has been made a department of State concern, the advancement, the public sentiment and the activity are good beyond criticism. It seems that every effort which the Board made to promote and stimulate right forestry conduct was received by the people of the State with a willing response and a promptness that realized its intentions. This enthusiastic

assistance in behalf of this prime movement from the public-spirited citizens of the State is cause for the highest praise and merit, and the Board unqualifiedly acknowledges its obligations to the Governor and General Assembly of Indiana, the public press, the officers and teachers of the public schools, the officers and members of the farmers' institutes, the members of civic organizations and the private citizens for their help and influence in the successful progress of forestry and its better establishment as a State institution.

The last General Assembly by enacting into laws S. B. 34 and H. B. 98 secured to the Board the means and the opportunity to accomplish forestry work of a good degree, and to give to the citizens demonstrative evidence and information of practical use. By the means thus afforded the Board will be able to advance forestry information from the theoretical phase to the real fact by actual performance. But let the citizens bear the following three things well in mind:

1. The Board, to enable it to conduct the experimental forestry work to benefit the public demands, must know the public wishes and desires.

2. The Board will use its best judgment in conducting experiments which will result in the best practical forestry information for the general people.

3. Forestry is not a matter of a year's development, and consequently patience, time, labor and money must be exercised and spent in the development of correct experiments and thereby right information ascertained for dissemination.

The unfolding of the present forestry organization, the bills formed for enactment into laws and the lines of forestry work now being carried forward were evolved from the inquiries made by the patrons of the office who sought knowledge pertaining to forestry interests, and the future efforts will be likewise directed.

The forestry discourses herein submitted are aimed to guide and instruct those who may wish to perform work upon their own lands and to observe forest influences. They are also aimed to give a knowledge of the character of and the plans for the State Forest Reservation and Experimental Station and a general knowledge of trees and their characteristics. The constant aim

throughout is to direct and instruct in the most practical, common sense ways and methods.

In conclusion the Board urges the necessity for the future concerted action and interest in forestry by the entire people, as beyond doubt the time is at hand when the cultivation of forests is vital to the general welfare of the State.

INDIANA STATE BOARD OF FORESTRY,
W. H. FREEMAN, SECRETARY.

FINANCIAL STATEMENT.

November 1, 1902, to October 31, 1903.

APPROPRIATIONS.

Annual appropriations by the General Assembly, 1901—

Office expenses.....	\$600 00
Salary of Secretary.....	1,200 00

**Emergency appropriations by the General Assembly,
1903, and available Feb. 28, 1903—**

Office expenses.....	400 00
Salary of Secretary.....	400 00
Salary of stenographer and clerk to Secretary.....	400 00
Salary and mileage for members of Board.....	277 18
Purchase of 2,000 acres of land for State Forest Reservation and Forestry Experimental Station.	16,000 00
Expenses for management and labor of State Forest Reservation and Forestry Experiment Station..	2,000 00
Total appropriations for year.....	\$21,277 18

EXPENDITURES.

Office—

Mileage	\$346 47
Stenographer to February 28.....	211 00
Fixtures and incidentals.....	176 63
Postage	220 00

Commission Expenses—

F. C. Carson, salary and mileage as member of Board	86 50
Stanley Coulter, salary and mileage as member of the Board.....	73 48
Albert Lieber, salary as member of Board.....	58 60
John Cochrane, salary as member of Board.....	58 60

Reservation and Forestry Experimental Station—

Purchase of 2,000 acres, correct titles and abstracts.	16,000 00
George Barnett, custodian.....	200 00

Topographical and biological surveys and expenses.	\$438	58
Team, wagon, harness and implements.....	312	78
Material for buildings and improvement.....	194	87
Manual labor and incidentals.....	853	77
<hr/>		
Total of expenditures.....	\$21,277 18	

FORESTRY LAWS OF INDIANA.

AN ACT to establish a State Board of Forestry, defining its powers and duties, and creating the office of State Forester and Secretary of said Board, and fixing the amount of his salary and allowance for his expenses.

(H. 192. Approved March 1, 1901.)

Section. 1. Be it enacted by the General Assembly of the State of Indiana, That a board is hereby created and established, which shall be known under the name of the State Board of Forestry. It shall consist of five members, who shall be appointed by the Governor, as follows: One from the membership of the State Forestry Association, one from the membership of the Retail Lumber Dealers' Association of Indiana, one from the faculty of Purdue University, one from the woodworkers of the State, who is a mechanic actively employed at his trade, and one who shall have special knowledge of the theory and art of forest preservation and timber culture, and technical knowledge of the topography of the State, and said last described member shall, upon his appointment and qualification, become and be the secretary of said board and ex-officio State Forester. All of said members of said board shall hold their offices for four years and all except said secretary and State Forester shall serve without compensation. A majority of said board shall constitute a quorum, and said board shall annually elect from its number a president.

Sec. 2. Before entering upon the discharge of their duties, the members of said board shall each take and subscribe an oath of office before the Clerk of the Supreme Court that they will faithfully and honestly discharge the duties of said offices, which oath of office shall be filed in the office of the Secretary of State.

Sec. 3. The board shall meet at least once each quarter in the city of Indianapolis, and as often as they may deem necessary upon five days' notice signed by the president and secretary, and in the absence of the president, a chairman shall be chosen to preside. The minutes of all meetings shall be recorded by the secretary in a book to be kept for that purpose.

Sec. 4. It shall be the duty of said board to collect, digest

and classify information respecting forests, timberlands, forest preservation and timber culture, and to recommend plans and methods for forest preservation and timber culture and for the establishment of State forest reserves. The board shall, annually, on or before the first day of December, file with the Governor a report.

Sec. 5. The secretary of the board shall keep his office at Indianapolis, in a room to be furnished said board by the custodian of the State house, and shall perform such duties as are prescribed by this act or may be required by the board; and he shall, as far as practicable, submit to the associations and meetings of timber dealers, woodworkers, farmers and engineers of maintenance of way of railroads, information and facts as to forests and timber.

Sec. 6. The secretary (and State Forester) shall receive an annual salary of twelve hundred dollars and an allowance for expenses of his office and his traveling expenses not exceeding six hundred dollars. Said secretary shall give his exclusive time and attention to said office and shall not hold any other office, appointment or position other than herein provided for. The president of the board shall quarterly certify the amount due the secretary upon vouchers duly attested by the secretary before some officer authorized to administer oaths, and the amount so certified shall be paid to the secretary out of the treasury of the State upon warrant of the Auditor of State.

Sec. 7. Whereas an emergency exists for the immediate taking effect of this act the same shall therefore be in force and effect from and after its passage.

AN ACT to amend Sections one (1) and six (6) of "An act to establish a State Board of Forestry, defining its powers and duties, and creating the office of State Forester and Secretary of said Board, and fixing the amount of his salary and allowance for his expenses," H. 192, approved March 1, 1901, the same being Sections 6628k and 6628p of Burns' Annotated Indiana Statutes, Revision 1901, and declaring an emergency.

(S. 34. Approved February 28, 1903.)

Section 1. Be it enacted by the General Assembly of the State of Indiana, That Section 1 of said act be and the same is hereby amended to read as follows: Section 1. That a board is hereby created and established which shall be known under the name of the State Board of Forestry. It shall consist of five members, who shall be appointed by the Governor, as follows: One from the membership of the Hardwood Lumber Dealers' Association of Indiana, one from the membership of the Retail Lumber Dealers' Association of Indiana, one from the faculty of Purdue University, one who is actively engaged in farming, and one who shall have special knowledge of the theory and art of forest preservation and timber culture and technical knowledge of the topography of the State, and the last described member shall, upon his appointment and qualification, become and be the secretary of said board, ex-officio State Forester and Superintendent of State Forest Reserves. All of said members shall hold their offices for a term of four years, and each of said members, except the secretary, who is hereinafter provided for, shall receive a salary of one hundred dollars per annum and mileage not to exceed three cents a mile for necessary miles traveled in attending necessary meetings of said board. Said salary and mileage shall be paid out of the treasury of the State upon warrants of the Auditor of State, and the members shall certify the amount due them, separately, upon vouchers duly attested before some officer authorized to administer oaths. A majority of said board shall constitute a quorum, and said board shall annually elect from its number a president: Provided, That members of the board heretofore appointed shall serve during the term for which they were appointed.

Sec. 2. That Section 6 be and the same is amended to read as follows: Section 6. The secretary shall receive an annual

salary of eighteen hundred dollars. For expenses of office and traveling, an amount not exceeding \$1,000; clerk, six hundred dollars (\$600). Said secretary shall give his exclusive time and attention to said office and shall not hold any other office, appointment or position other than herein provided for. The president of the board shall quarterly certify the amount due the secretary upon vouchers duly attested by the secretary before some officer authorized to administer oaths, and the amount so certified shall be paid to the secretary out of the treasury of the State upon warrant of the Auditor of State. That expenses of publication shall be paid from the expense fund of the State Printing Board.

Sec. 3. Whereas an emergency exists for the immediate taking effect of this act, therefore the same shall take effect from and after its passage.

AN ACT to provide for the purchase of land by the State Board of Forestry for the purposes of a State forest reservation, laboratory of forestry demonstration and State nurseries, and to provide for the management and location of the same, and declaring an emergency.

(H. 98. Approved March 3, 1903.)

Section 1. Be it enacted by the General Assembly of the State of Indiana, That there be and is hereby set aside a sum of money out of any money not otherwise appropriated, sufficient to purchase two thousand acres of land by the State Board of Forestry for the purposes of a State forest reservation, laboratory of forestry demonstration and State nurseries, and that the sum of one dollar and fifty cents per acre annually thereafter be allowed to defray the expenses of management and labor of the same.

Sec. 2. The Board of Forestry shall purchase said land in any county or counties of the State, which, in its judgment, affords the best opportunities for the purposes prescribed: Provided, That the land so purchased shall not exceed a cost of eight dollars per acre, and the land so purchased shall be taken in title in the name of the State of Indiana.

Sec. 3. The Board of Forestry shall manage and shall establish such rules and regulations governing the management and work as are necessary to execute the plans it may project, and

the expense of the same shall be paid quarterly from the fund designated for that purpose out of the State treasury, upon warrant by the Auditor of State when vouchers are presented to said Auditor duly certified to by the president and secretary of the board before some officer authorized to administer oaths.

Sec. 4. The secretary of the board shall receive all money to which the State may be entitled by reason of the sale of any timber, leases, contracts for the mining and removal of minerals or from any source whatever from such land, and he shall immediately pay the same over to the State Treasurer as a part of the revenues of the State, and the secretary shall give his bond, to the Governor of the State, in the sum of five thousand dollars for the faithful discharge of his duty.

Sec. 5. Whereas an emergency exists for the immediate taking effect of this act, the same shall therefore be in force and effect from and after its passage, and all laws and parts of laws in conflict with it are hereby repealed.

STATUTORY LAWS FOR THE PROTECTION OF FORESTS AND ORNAMENTAL TREES.

(Burns' Revised Statutes, 1901.)

Section 2001 provides a fine of not more than \$100 nor less than \$5, to which may be added imprisonment in the county jail not exceeding thirty days, for maliciously or wantonly setting fire to any woods, or for permitting a fire to pass from his own property to the injury or destruction of the property of any other.

Sec. 2040 provides a fine of five times the value, to which may be added imprisonment not exceeding twelve months in the county jail, for whoever cuts down or destroys or injures any bush, sapling or tree on the land of any other person, or on land belonging to the State or county or township, or any land reserved by county for the use of schools or seminaries, without license to do so from competent authority.

Sec. 2041 provides a fine of not more than \$500 nor less than \$50, to which may be added imprisonment in county jail not exceeding six months, for wilfully, mischievously or maliciously disfiguring, defacing or removing any tree, shrub or plant in or around any public or private cemetery or burial place.

Sec. 2042 provides a fine of not more than \$500 nor less than \$50 for whoever shall wilfully, maliciously or mischievously and without right cut down or in any way injure any tree on a public highway.

Sec. 2048 provides a fine in any sum not more than \$50 nor less than \$3 for whoever removes, destroys, cuts or girdles any shade tree, or carries off or removes or in anywise injures the protecting box of any shade tree in any city, town or village of this State, provided, however, that this section shall not be construed as to prevent any owner of grounds from making any necessary alterations in the walks or trees on the same.

AN ACT for the encouragement of Forestry.

(H. 436. Law without Governor's Signature, March 8, 1899.)

Section 1. Be it enacted by the General Assembly of the State of Indiana, That upon any tract of land in the State of Indiana, That upon any tract of land in the State, there may be selected by the owner, or owners, as a permanent forest reservation, a portion not to exceed one-eighth of the total area of said tract, which shall be appraised for taxation at one dollar per acre.

Sec. 2. If such selection is an original forest, containing not less than 170 trees in each acre, it shall become subject to this act upon filing with the Auditor of the county in which it is situated, a description of such selection as is hereinafter provided.

Sec. 3. If any land owner shall plant not less than 170 trees on each acre of selected forest reservation, and shall cultivate and maintain the same for three years, then it shall become subject to this Act, as herein provided.

Sec. 4. Upon any tract selected as a forest reservation which contains 100 or more original forest trees on each acre, the owner may plant a sufficient number of forest trees which shall make up the required 170 trees per acre, when the same shall become subject to this act, as in Section 3.

Sec. 5. No land owner shall receive the benefit of this Act who shall permit cattle, horses, sheep, hogs or goats to pasture upon such reservation until said trees are four inches in diameter.

Sec. 6. Whenever any tree or trees shall be removed or die, the owner in order to avail himself of this act shall plant other trees in place of such trees as may be removed or die, and protect said trees until they are four inches in diameter, shall plant others which shall at all times maintain the full number required by this act.

Sec. 7. Not more than one-fifth of the full number of trees in any forest reservation shall be removed in any one year, excepting such trees as may die naturally may be removed, when other trees shall be planted.

Sec. 8. Ash, maple, pine, oak, hickory, basswood, elm, black locust, honey locust, Kentucky coffee tree, chestnut, walnut, butternut, larch, tulip tree, mulberry, osage orange, sassafras and catalpa shall be considered forest trees within the meaning of this act.

Sec. 9. It shall be the duty of the Auditor in every county to keep a record of all forest reservations as the same shall be filed with him, and he shall require the owner or agent to subscribe under oath the extent and description of the land reserved, and that the number of trees is as required by this act, and that he will maintain the same according to the extent of this enactment.

Sec. 10. It shall be the duty of the Assessor to personally examine the various forest reservations when the real estate is appraised, and to note upon his return the conditions of the trees, in order that the intent of this act may be complied with. And if the reservation is properly planted and continuously cared for, he shall appraise the same at one dollar per acre.

FORESTRY OBSERVANCE AND INTEREST OF THE PEOPLE IN THE STATE.

The spirit and conduct as concerns forestry by the citizens of Indiana is excellent. The growth of sentiment in favor of planting trees and preserving the forests is deserving of the highest commendation. The secretary in addition to the work of promoting Forestry by the State as shown by that report made 207 recommendations for tree planting and forest culture extending into all parts of the State.

The work is being well presented and received at Farmers' Institutes. Local speakers are enthusiastically urging the need of forestry attention. The public schools are observing Arbor Day with a spirit that is telling its own story in the work done by them in the tree planting on the school grounds and elsewhere for decoration. It is hoped that the schools will carry this tree culture enthusiasm forward to an observance of systematic forest culture in the respective communities.

The number of trees planted by the schools last year was 31,736, and while no statistics have been taken by school superintendents and reported it is evident from accounts given of Arbor Day observance by the schools that a far larger number was planted the present year. The number of trees planted by farmers last year was 123,675. The report for this year by the State Statistician shows that 218,495 were planted. Nurserymen report that Indiana and Ohio were planting more trees than any other States from their accounts, and their stock became exhausted very early this season. No efforts they could make were sufficient to fill the demands for the post timber trees. I do not believe the above number includes the trees planted for such purposes as the last named, as I personally know that the number given nowhere equals the number of catalpa, locust, osage, chestnut and mulberry planted for the purposes of posts, ties, telegraph and telephone poles.

It is encouraging to note the progress in tree planting and the cultivation given the forests. A trip through the State reveals signs of forest cultivation on every hand. It, however, is urged

that more of the stable merchantable hardwoods be planted. The demands for young second growth oak, ash, hickory, elm, walnut, cherry, lin and other kinds of the best qualities of woods will far exceed the demands for the kinds now being so abundantly grown, though I do not discourage the present attempts, as there will always be a big demand for them. Forests of cultivated hardwoods will in a short time reveal growth not imagined at the present time and the returns are not nearly so distant in time as now thought.

The act of 1899 for the encouragement of forestry, by which owners of timber land could exempt a portion of their land from taxation has not proven a success. Last year there were 560 exemptions recorded by the county auditors, and the present year the number was more than double, but the assessors found in making their examinations that almost 99 per cent. of them failed to meet the requirements of the law and were rejected from the benefits of the act. The enforcement of the law proved its weakness. There are not more than two dozen exemptions now standing. The law is weak in almost every detail. I think some law should be made that will be beneficial and practical in operation for the encouragement of planters, but evidently the present law should be repealed and ninety of the ninety-two county auditors so expressed themselves, and the results justify their assertions.

The conduct of the owners who had claims and which were rejected will indicate whether the law was taken advantage of for personal gain or forestry interests by the attention and retention of the forests owned by them in the future, and will determine what should be done.

THE STATE FOREST RESERVATION.

HISTORY AND LOCATION.

The State Forest Reservation and Station for Forestry Experimental Demonstration and State Nurseries has a historical relation which should be given full credit along with the fitness of the site for the purposes intended. By referring to the early history of the conquest of the Northwest Territory, especially that part concerning the reduction and capture of the posts, Kaskaskia and Vincennes, by General George Rogers Clark, and to the deeds of cession by Virginia in 1784, some of the historical associations connected with the territory of which the land now



CUSTODIAN'S RESIDENCE AND HEADQUARTERS ON GRAND VIEW
KNOB AT THE FOREST RESERVATION, HENRYVILLE, INDIANA.

forming the above reservation is a part may be known. The following is an extract from the deeds of cession and pertaining directly to the above territory:

"That a quantity not exceeding one hundred and fifty thousand acres of land, promised by Virginia, shall be allowed and granted to the then Colonel, now General George Rogers Clark, and to the officers and soldiers of his regiment, who marched with him when the posts of Kaskaskia and Vincennes were reduced, and to the officers and soldiers that have since been incorporated into the said regiment, to be laid off into one tract, the length of

which not to exceed double the breadth, in such place on the northwest side of the Ohio as a majority of the officers shall choose, and to be afterward divided among the officers and soldiers in due proportion, according to the laws of Virginia."

The land for the Reservation is located within the grant of land described in the above extract, and the greater part of it is in grant No. 269. Besides the pleasing historical connections just related, it is further interestingly linked with romantic fiction by the late Maurice Thompson in the story, "Alice of Old Vincennes." Captain Leonard Helm, who commanded the fort, Vincennes, and who is made the hero of the romance, was an officer of General Clark, who received a grant of land, some of which is contained within the Reservation tract.

The definite location of the Reservation is Monroe township, Clark county. It is twenty miles north of Jeffersonville and ninety miles south of Indianapolis, and fronts for three-fourths of a mile on the Pennsylvania railroad at the station of Henryville. The site extends west from the railroad three miles in a very regular form which is seen by referring to the map of the same.

The bill providing for the purchase of the Reservation was approved March 3, 1903. Activities were immediately begun to secure a site. By the aid of the county auditors, in such counties as possessed lands and conditions available under the law, responsible parties were secured to locate lands and take the options. In a reasonably short time thirty-two tracts were offered to the board for its consideration. The board met and deliberately considered the various offers and from their points of advantage rejected all but eleven, and so notified the bidders. These favorable sites were visited by the secretary of the board and thoroughly inspected, and of these all were rejected but three. The president and secretary of the board together with a few invited friends visited these three choice sites and thoroughly considered the merits and demerits of each from all the points of adaptability, public convenience and public influence, and ordered the contesting parties to submit map of site and secured options in writing for the final decision of the board at its meeting April 24th.

Upon the convention of the board at that date the offer of Ramsey R. Freeman and M. H. Dunlevy, of Henryville, Indiana, was accepted and a written contract entered into for the final purchase and transfer. On May 28th the completed deeds and abstracts were presented and accepted by the Attorney-General, and the owners of the seventeen farms contained in the tract were paid in full and the State took possession of the land.

THE CHARACTER AND CONDITION.

The general character of the tract will not be given full discussion here as the reports of the biological and topographical surveys will very fully cover all the details of soil, elevation and plant life. The points herein given are such as are outside of the surveys.

Aside from the historical interest which the Reservation attracts, and the sympathy of forestry interest, there are many beautiful landscape views which please all visitors to the site. The knob lands forming the western part of the tract possess views not excelled in either of the highland regions of the United States except in magnitude. There are level and rolling lands, peaks and valleys, ravines and gorges, slopes covered with vegetation and rockribbed cliffs all mingled in pleasing harmony.

The purchase of this land by the State has realized a thought which has long been fostered in the minds of the public-spirited citizens of the community. It has long been believed by them that the attractiveness so copiously displayed by nature and the opportunities for artificial enrichment would justify its being made the object of a State interest of some kind.

The general improvements on the land are very meager. The entire tract was in an unorganized state, and far the greater amount was wild waste by haphazard farming and wilful devastation of every sort. Prior to the present time the boundaries were indefinite, and in some instances not known at all. The timber land has been devastated constantly by cutting and fires. Fields were farmed without rotation or fertilizing until unproductive and then abandoned as waste land. Every possible magnificence of the tract was abused and disregarded. But the great

majority of the people are a unit in sympathy with any movement which will advance it to its highest possibilities.

WORK ACCOMPLISHED.

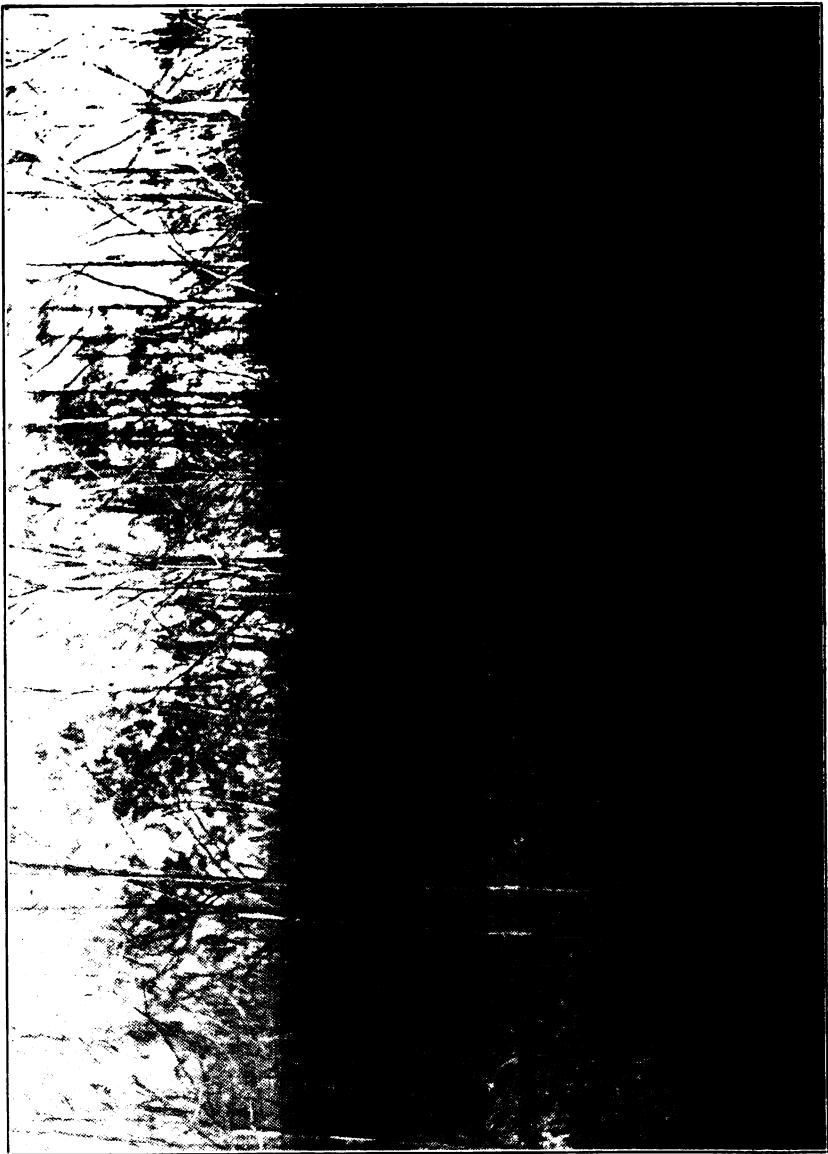
Because of the unorganized condition and of the opportunities to make the site attractive and therefore inviting to the public and consequently influential in stimulating the public sentiment to the things and purposes for which it is intended, the first efforts of the board were directed toward placing the tract in a definite, organized form for operation and protection. One of the most commanding elevations, Grand View Knob, was selected for the headquarters buildings and residence of the custodian. This highland has an elevation of 1,025 feet above the sea level and 415 feet above the mainland of the Reservation. The object of the selection were the advantages for detecting and locating fires by the custodian should they occur and the climax of view afforded.

The old home which was formerly occupied by the proprietor of the "Knobs Fruit Farm" and which was located on the above knob has been remodeled and made a comfortable home. A small but sufficient barn has been erected, with other outbuildings, for the shelter of teams, feed, implements and the general convenience of the custodian. Two other residences have been preserved for homes of the permanent assistants and laborers on the Reservation. All other buildings are being removed, as they are rude huts for the most part.

Some roads have been roughly made for the necessary travel and transportation, but means has not permitted anything like satisfactory road building. The road up the knob to headquarters was a giant undertaking, but a passable one was secured around and up by a gradual ascent of less than one-inch slope to the foot by excavating on the hillside to an average depth of about eight feet and from twelve to fifteen feet wide for nearly a half of a mile. With more expense and time a very satisfactory road can be constructed up the knobs. The topographical map will show the extent of the roads thus far laid out and rudely built. There are plenty of good gravel and stone at hand to build first-class roads at a very reasonable cost if the appro-

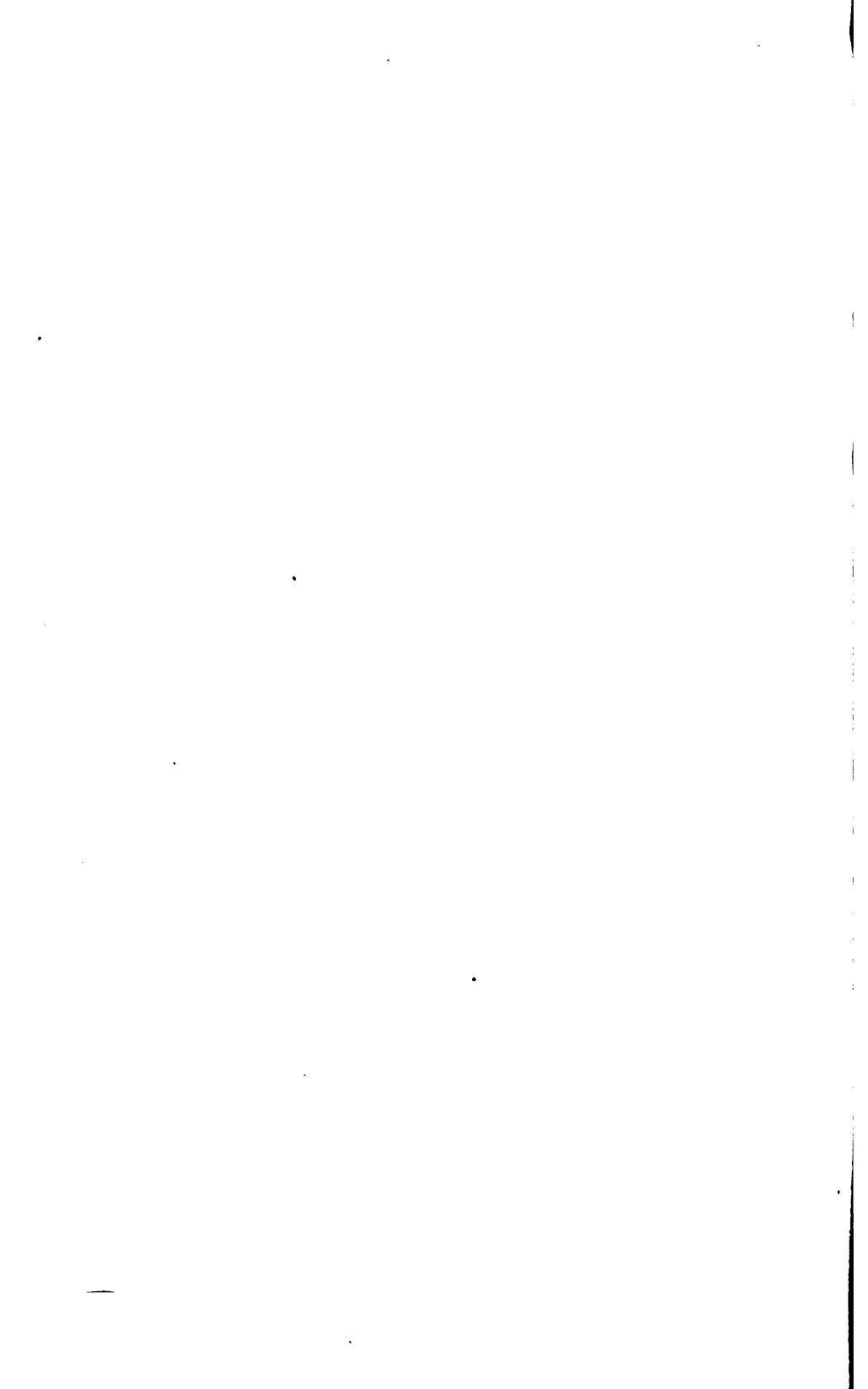


A VIEW SHOWING THE YOUNG FOREST GROWTH ON THE RESERVATION BEFORE CULTIVATION.





A VIEW SHOWING THE YOUNG FOREST GROWTH ON THE RESERVATION AFTER CULTIVATION.



priation were sufficient to carry on the general improvement and timber culture, but with the present finances the road building must be neglected.

A very satisfactory beginning was made the past summer at cultivating the young timber. The greater amount of the timber now covering the larger portion of the tract is dense coppice of both sprout and seedling growth and averaging in age from one to fifteen years. Very little of the larger timber remains and is all more or less greatly damaged by forest fires which have occurred almost annually for many years. The constant fires, the jungle from cutting timber for years and allowing the rubbish to lie, the abundant sprouting from the stumps and the rich growth of seedlings from the seeds present a task of culture which at first sight seems hopeless as far as making progress, but the contrary is the result. It is the most encouraging feature of the work. The two photographs here given show how encouraging are the results for securing a permanent forest of the best commercial hardwoods. About one hundred acres of this forest was cultivated to determine the results of the work when accomplished. All the trees unfit to remain for a permanent forest, by reason of injury or otherwise worthless as species, were cut and removed to a fuel yard. The same thing was done with all the down timber. The trees left standing and selected to form the future permanent forest were properly pruned to admit of the best trunk formation. All the litter and rubbish were leveled to the land surface and left to decay and form a leaf mold and cover to the soil as well as prevent evaporation and keep down the weeds. It was not piled into heaps as is usually done. This is always the better method to follow when a strict guard can be maintained against fire. The result of this work showed that there remained from 900 to 2,000 perfect young hardwood trees to the acre, from which, by following successive thinnings when crowding occurs, to select the permanent forest for large growth. It is very evident that such a large number of trees can not be sustained to the acre into large trees, but periodical thinnings will be made when necessary to secure the best grade of forest. All thinnings will be utilized for whatever uses suitable and from which the most can be realized. The area now in timber which

needs this culture is about 1,400 acres. It will require several years to perform this work.

There has been very little done toward planting the cleared land to trees and seeds, because the purchase of the land was not completed till after the crops were planted and the planters reserved the right to mature and harvest them, and also because forest seeds could not be secured in time to do much planting this year. The seed crop in Indiana was very meager in yield and inferior in quality, and consequently the greater amount of the seeds secured were imported from other States, which has greatly delayed planting, besides increasing the expense of the same.

There are now stored in sand at the Reservation, for planting either this fall and winter or next spring, depending on the climate to permit soil preparation, 26 bushels of black walnuts, 10 bushels of shellbark hickory nuts, 262 pounds of American white ash seed, 4 bushels of American chestnuts, and 8 bushels of acorns. Much difficulty was encountered in securing this quantity and variety of good seeds.

PLANS AND PURPOSES.

The plans and purposes of the Forestry Station may be well understood by most persons who are interested in the work of forestry, but a complete outline of the aims may not be unnecessary for those who are not so well informed concerning them.

The plans embrace the following phases of forest cultivation, experiments and derivation:

I. Natural forests—

1. Methods and results of improvement cuttings.
2. Methods and results of reproduction cuttings.
3. Methods and results of pruning.
4. Methods and results of regeneration by seeds and seedlings.
5. Methods and results of successive thinnings.
6. Ascertaining the productive capacity per acre for trees at various ages and to maturity to determine the frequency and the extent of the successive thinnings, the age of maturity and the age of best quality of timber for the different kinds of trees; the best method, most profitable product and the right season to harvest the trees at different stages of growth.

II. Cleared fields—

1. Methods and results of soil preparation.
2. Methods and results of planting with seeds.
3. Methods and results of planting with seedlings.
4. Ascertaining the best distances at which to plant the different trees to secure the best results; the results of mixed and pure plantings from both seeds and seedlings; the required culture to the stage of survival and to the stage of natural forest attention as given under "I" above.

III. Nursery for the supply of seeds and seedlings to planters within the State upon application and for agreed purposes of forestry—

1. Methods of gathering seeds and treatment for planting.
2. Methods of broadcast and row planting of seed in nurseries for seedlings.
3. Methods of and serial transplantings and prunings of seedlings for ornamental trees of large size.
4. Open long-distance plantings of the different species of trees for seed orchards, and to determine shade-tree culture and selection.

IV. Scientific—

1. Tree diseases, causes and remedies.
2. Insecta, life history and remedies.
3. Temperature and moisture observations.

The first three divisions of the outline will be given the emphasis of first attention, as they cover the points which the patronage of the office has indicated that it desires information concerning. They are also the things which the board feels should be first demonstrated and the correct knowledge derived for the public benefit. Time, circumstances and investigation will naturally suggest other points or may modify the present plans, but the present aim is to execute closely the above course. The reservation tract will be plotted to carry forward the various phases of the above outline, and all operations and results will be recorded and reported together with the topographical conditions directly connected.

It must be very apparent to all that years of time, patience, work and much expense will be required to perfect the plans

herein given. But when it is recalled what a great factor the past abundant timber supply has been to the prosperous, industrial condition of the State, and what it will mean when the supply is exhausted, no effort can be too great to perpetuate the forests. Surely no greater problem of industrial supply confronts the American industries. Indiana by nature is a tree-growing State. Every condition is favorable to successful forestry. The people have but to know the right processes, do them, have patience and be rewarded either themselves or their generations.

REPORT OF TOPOGRAPHICAL SURVEY.

The survey of the Indiana State Forest Reservation was made by Sophomore and Junior students from the Civil Engineering Department of Purdue University. The party consisted of six assistants—A. D. Faulkner, W. L. Harrison, Manual Rivera, W. J. Ryan, C. E. Shearer and E. G. Sevendsen, in charge of R. V. Brewster. They were assisted by Ramey R. Freeman, of Henryville, Indiana.

The equipment, consisting of two transits, two levels, hand levels, tapes and many smaller instruments, was loaned by the Civil Engineering Department of Purdue.

The northern half of the Reservation lies in the sections and the southern half lies in the Illinois Grants, which were given to the soldiers of General George Rogers Clark. The western, and part of the northern boundary is on the line between Scott and Clark counties. The knob region lies entirely in the northern part, and is practically all heavily timbered. Several peaks have an elevation of over 1,000 feet above the sea level. The larger creeks lie in the southern part and none of them run freely except in the spring and rainy seasons.

The entire survey covered a period of nine weeks. The survey of the boundary began June 15th, 1903, and was finished July 8th. The time in making this survey was greatly lengthened by the rough land and the heavy undergrowth. Along the northern and western boundaries in the knob region, the hills were very steep, and much of the distance was measured by means of broken chain. Many settings of the instrument were required. The perimeter of the tract is nine and one-half miles, most of which is through dense undergrowth.

While making the survey of the boundary, a complete set of notes was kept of the topographical conditions, in addition to the traverse notes. The lines were run with a complete engineer's transit and the distances measured with a one hundred-foot steel tape.

The topographical survey began July 9th and was completed August 15th. The elevations were taken from the sea level bench

marks of the P., C., C. & St. L. R. R. Levels were run around the boundary, and bench marks were established at regular intervals. The northern grant line of the Illinois Grants was taken as a base line from which the survey was started. Stakes were set at intervals of six hundred feet and elevations determined. Perpendicular lines were run from these base line stakes and the distances measured by means of the transit and stadia. These elevations were checked by the bench marks along the boundary.

The topography party followed the transit party, and a complete set of notes and sketches were made in the field. The topography between the transit lines and along the hill sides was taken with hand levels.

Field sketches, showing the roads, contours, creeks, timber and cleared lands were drawn at a scale of one hundred feet to the inch. The roads, ridges, and creeks were traversed and elevations carried along them.

The final map showing the boundary and topography was reduced from the field notes and sketches to a scale of four hundred feet to the inch.

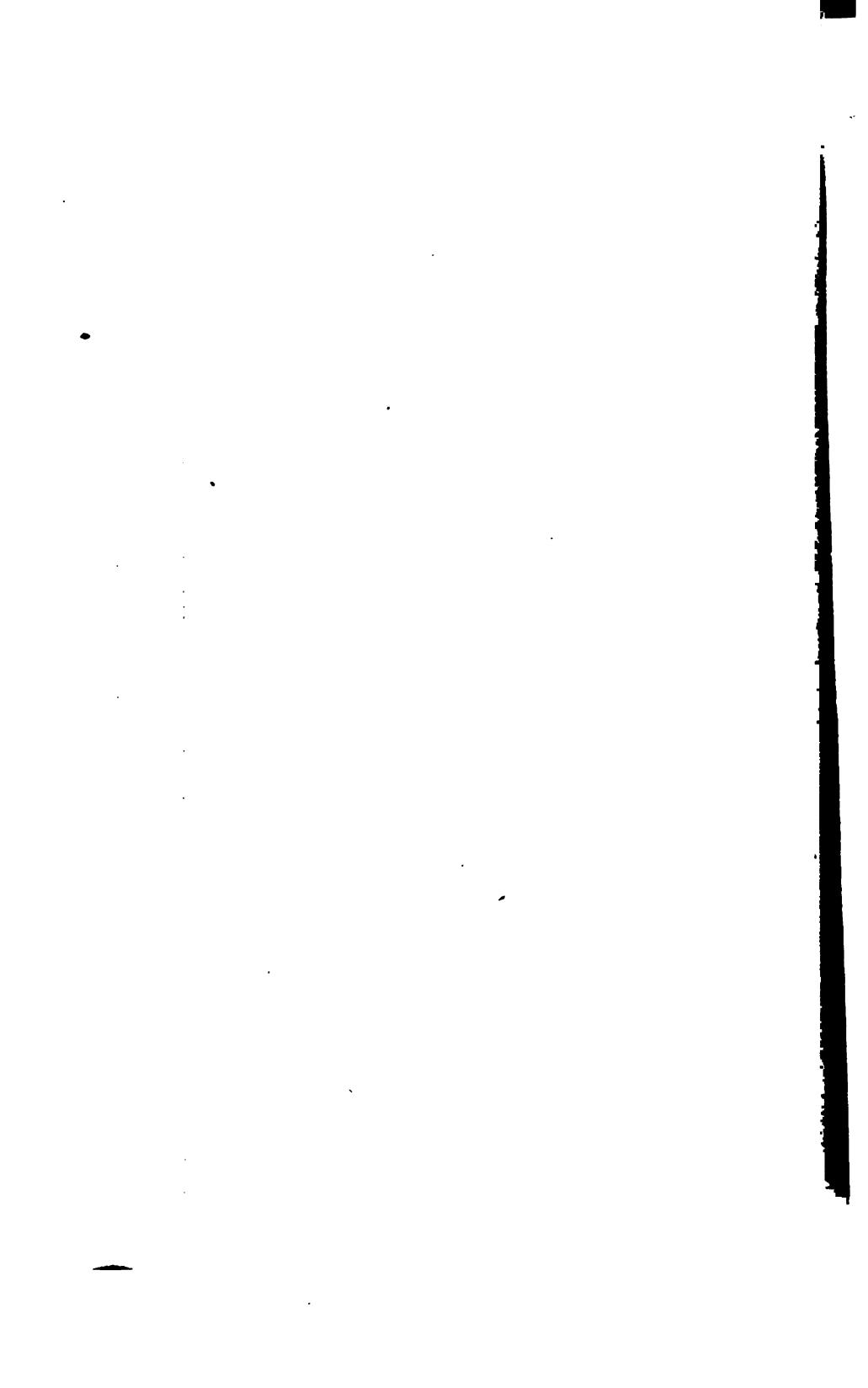
ROGER V. BREWSTER,
Chief of Survey.

December 5, 1903.

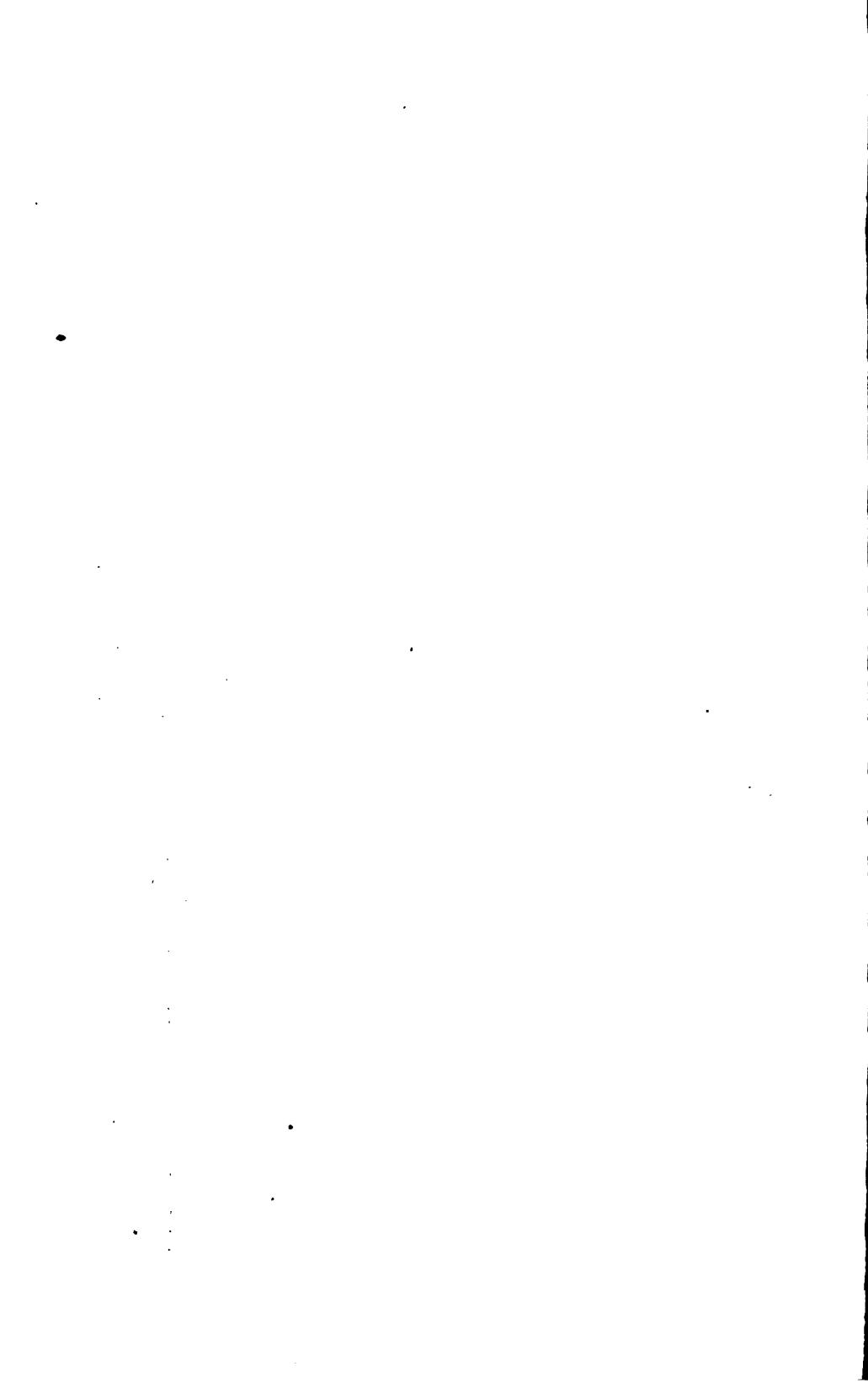


E. G. SEVENDSEN, A. O. FAULKNER, W. J. RYAN, R. V. BREWSTER, W. L. HARRISON, M. RIVERA, C. E. SHEARER AND C. PIPER SMITH.

Purdue students of the Civil Engineering Department, who made the topographical survey and map, and C. Piper Smith of the Science Department, who made the botanical survey and map of Indiana Forest Reservation and Station of Forestry Demonstration.







THE FARM FOREST.

There is at the present time a strong sentiment and demand by farmers, and other timber-land owners, for information and instruction of a common-sense, practical kind which will enable and guide them in conducting forestry work for themselves. They do not want to resort to expert foresters, but desire such advice as will direct them to perform their own forestry work in the most simple and effective manner. It is not to be understood, however, that expert forestry is not needed, or is not a good thing, but that there are conditions where it is not needed and is not sought or desired. There are landowners who have a good knowledge of the nature, the habits and the uses of trees and intend cultivating their farm forests or wood lots without employing others to do it. There is a judgment being formed in favor of perpetuating the timber areas after cutting a crop instead of clearing the land and putting it under agriculture. It is instruction for this kind of forestry work that the following discussions are intended.

PRESENT FOREST CONDITIONS.

The greater amount of the timber now growing in the State is second-growth hardwoods, either by sprouting from the stumps of the preceding trees which have been cut off, or by springing from seeds in the forest mold upon sunlight and air being admitted. The forms of the present forests are either wood lots or abandoned fields growing up and alternated by cleared fields, and will therefore, require more careful cultivation because of the climatic exposures.

The sprout forests are inferior to those growing from the seeds, and less valuable trees may be expected from them. The reason for this is that the stumps from which the sprouts grow become decayed and, therefore, affects the tree growing from it. It is to this cause that many of the decayed and hollow trees, especially at the butt, can be attributed. It is to this same cause that many of the trees die at an early age, become affected with disease, and are eaten by beetles and borers more than other trees in the same

locality. Each succeeding sprout growth will reveal more of these defects, because as the stumps decay more and are repeated they become weaker in vitality. It therefore stands the owner of a forest well in hand to anticipate these evils in the perpetuation of his farm forest by seeding it in conjunction with sprout cultivation.

In very old sprout woods it has been ascertained that the rate of annual decay often exceeds the annual increment, and as time elapses they become more ragged and open. It has been distinctly discerned that trees growing from stumps which were cut high and ragged are more defective than those growing from stumps cut low and smooth. The reasons for this are at once visible to the mind. Stumps cut high and ragged afford first, a chance for the sprouts to come out far above the ground and thus leave less chance to establish a root hold in the soil, and are, therefore, wholly dependent on the stump for nourishment; and, second, the ragged form of the stump affords greater opportunities for decay and thus destroys the chances of life to the tree growing from it. Stumps cut low and smooth obviate these difficulties and enhance the productiveness and promote the chances for permanent growth.

There are three phases of treatment which may be considered as the right things to apply to make the farm forest tracts successful. They are known as improvement cuttings, reproduction cuttings, and restocking with either seeds or seedlings. The following points will prove to be the right things to emphasize in applying treatment that the best results may be obtained.

1. Proper cutting of the stumps in removing trees to insure the right conditions for sprouting and nourishment.
2. Careful thinning of the sprout and seedling growths to obtain the strongest, best trees for the permanent stand.
3. Right pruning of the trees selected to stand, in order to form correct boles.
4. Restock the scanty parts and the portions possessing undesirable trees with seeds or seedlings of the right kinds.
5. Protect the forest from injury by fire, grazing and ruthless destruction in cutting trees when removing them for use.

CUTTING FOR IMPROVEMENT.

Improvement cuttings mean the removal of such trees as are the least promising, most unlikely and undesirable, and such as hinder the right development of the best trees desired for the permanent stand. The thinning out to a proper number to afford the right chances of growing to the selected trees intended to form the forest. It does not have in it the idea of a new growth, but simply the improvement of the existing stand of trees.

In the performance of this work judgment must be exercised not to cut out too much. A sufficient number should be retained to protect the soil from the sun and wind, which, if permitted too direct contact, will dry it out and hinder the trees from growing because of the lack of moisture, extravagant branching and the springing up of weeds and grass to sap the substance from the trees. The growth of weeds and grass and the lack of moisture will also prevent young trees which might spring up from the seeds from doing any good to form the succeeding crop when the older trees are cut off. A good rule to follow in this would be to, first, remove the dead and dying trees; and, second, such stunted medium and undesirable kinds as is necessary to the end sought. This plan will surely bear the stamp of utility, as the cutting out of the dead and dying trees will enable them to be used instead of remaining to decay and afford chances for a forest fire. Their removal heightens the advantages of growing to the standing trees. In some instances of wood lots which have never been thinned it will be found necessary to cut out the overtopping trees, as the young, healthy trees springing up beneath and hampered by their shade demand and justify release from their crowns. The individuals should give way to the many. Very frequently the cutting of those dominant trees gives the best results, as the young trees which they suppressed respond quickly to the conditions of light and soon fill the space made vacant.

There are two phases of improvement cuttings, the even and the uneven. The former has reference to cutting out all the trees down to a uniform size and repeating at periods of years (as every 15, 20, 30, or 40 years), depending on the wishes of the owner and the size of timber wanted. In most instances the time of repetition is about 20 years. The latter idea has reference

to no uniformity of size or period of years, but the cuttings are made at any stage of growth when material is desired and the conditions demand that cultivation be instituted. The latter plan is such as will be found preferable for farm forests where there are annual demands made on the timber for economic uses. The owner in selecting trees to cut for his purposes will study his forest and make his selection with the view of improving it instead of haphazard careless cutting anything and anywhere.

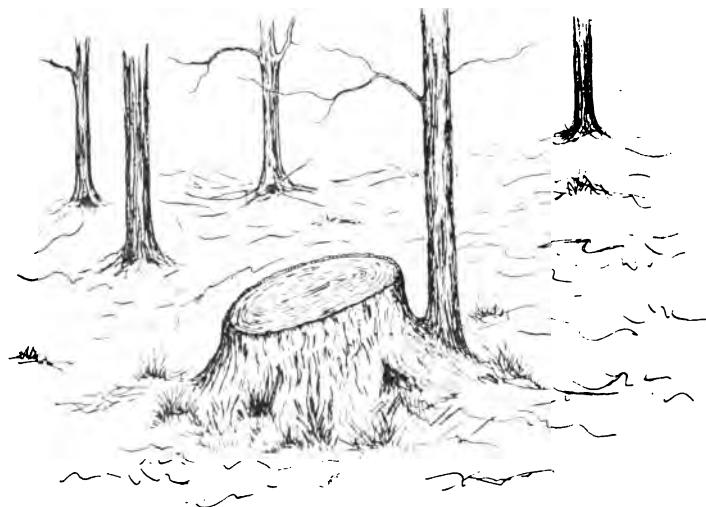
CUTTINGS FOR REPRODUCTION.

Cutting for reproduction is the process of forest cultivation whereby a new stand of trees is sought to replace the ones removed. Trees are selected and cut at different places over the forest to suit the idea of the party who is reproducing it, and are cut in such a manner and with the thought that either a growth of sprouts or seedlings will put up, or both may be in contemplation. Such forest cultivation is not calculated to produce the required forest, but is the initial to it. A forest obtained by this method, unaided, is uneven and irregular in almost every feature and must be followed through by the improvement cutting process to result in a finally valuable forest. Every principle of it will reveal this. The best trees are removed to cause the reproduction and the poor undesired kinds left, which must be gotten out of the way by the latter process. A reproduction forest pure and simple is inferior.

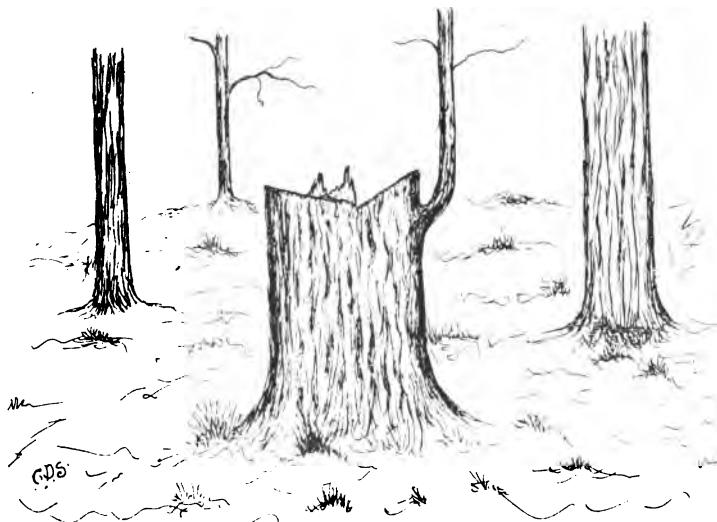
It is therefore evident that these two distinct processes of forest culture must be co-ordinated to secure the final successful aim, and the points 1 to 5 previously enumerated are the essentials for emphasis.

CORRECT STUMP CUTTING.

The stumps should be cut as close to the ground as possible, that the sprouting will not occur too far above the ground and thus lessen the chances of the sprouts to establish a hold in the soil for nourishment. They should also be cut smooth and slanting, to allow the water to run off, instead of remaining to soak into and rot the stump, thereby affecting the chances of sprout-growth and their thrifty condition. The bark should not be torn and split from the stump, because such will lessen the opportunities for



A PROPERLY CUT STUMP.



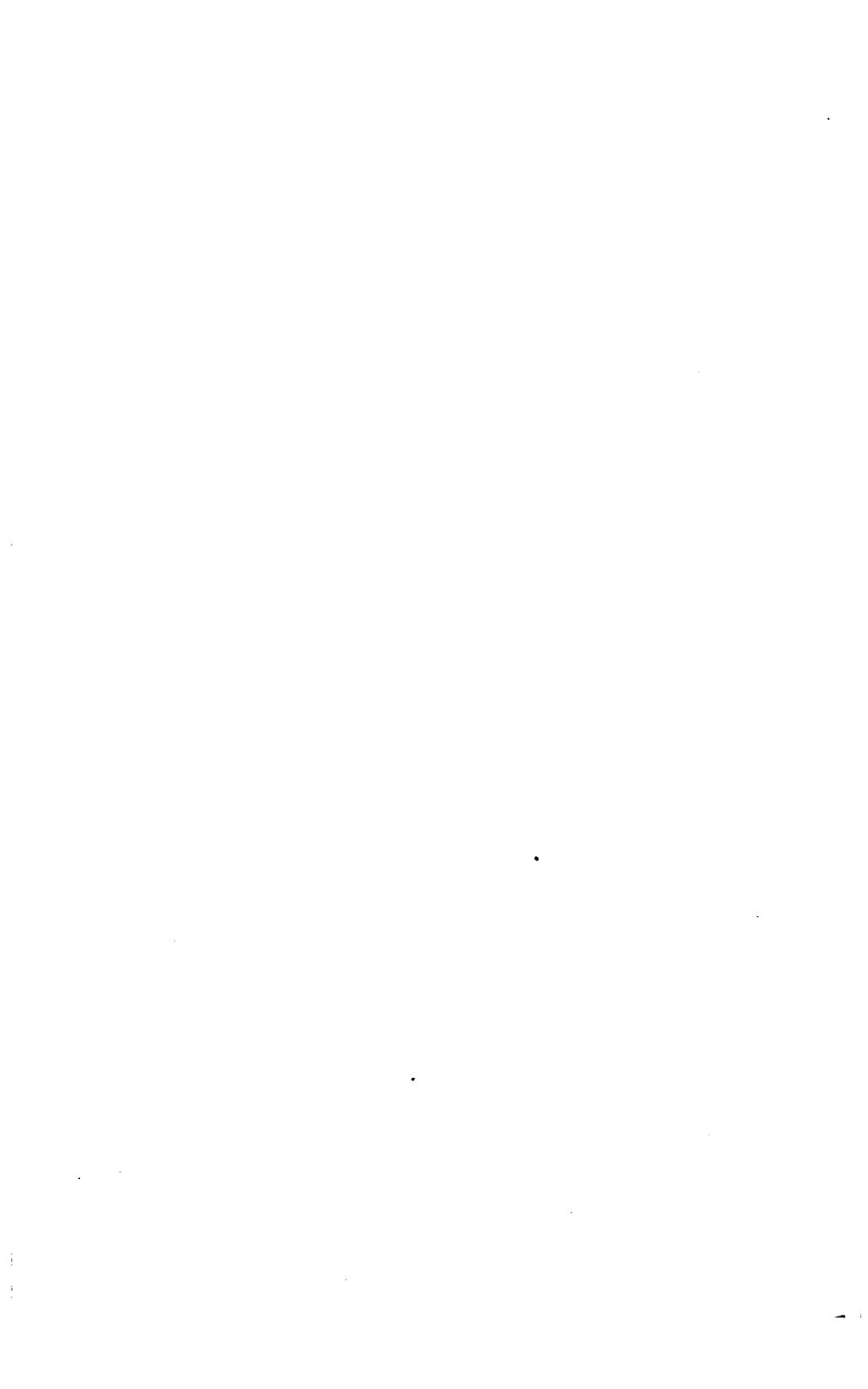
AN IMPROPERLY CUT STUMP.

buds to form and thereby sprouts; besides, the conditions for decay are heightened.

There are two seasons considered as the right times to cut trees to secure the best sprout growth. They are the season of down sap and the season of sap flow. The time of the former is from October to February in this climate and the latter is from February to June. These limits are the maximum. It is not at all advisable to cut in summer as the sprouts which may then put out are tender and immature for the winter and the freezing so affects them that they usually die the following season, or if they continue to live they are more or less inferior because of the damage resulting from the winter on account of their tenderness. As to which of the two favorable seasons is the better I am not sufficiently informed to dictate; however, the following points will help owners to decide for themselves. The stumps cut during the sap flow season sprout surer and more numerously than those cut in the down sap season, but the abundance of the sprouts is detrimental because it requires more work and expense to thin them and the sprouts are weaker because of the number. The stumps decay sooner when cut in sap-flow, and thus affects the permanent growth from them. The farmer finds his time occupied more with other duties in the sap-flow season, and will therefore not be able to devote such careful attention to the correct cutting.

The down-sap cutting fails in some instances to sprout, but the less abundance is very favorable, because less labor and expense is required in thinning and the sprouts are stronger and will mature better for the winter. The stumps season better against decay and consequently insure a stronger permanent growth to the forest. The farmer can also devote more care to the correct cutting, as at this time of the year the duties of the farm demand less of his attention.

In selecting trees to cut with the view of establishing a sprout forest it will be well to consider that old trees which are mature will not do any good at sprouting. The best results are obtained from trees from twenty to forty years old and in the best vital condition.





THINNING PROCESS.

This topic has been slightly mentioned under the topic, "Cutting for Improvement," but will be treated more fully. When the reproduction cuttings have been performed and the growth of the new forest is well established, thinning will become necessary, and the owner, to cultivate it, will want a definite plan of operation in mind. The following will be found a good course to follow:

1. Remove all the dead and dying trees.
2. Cut out defective trees, those possessing frog stools, canker, scars, hollows, girdles by fire and otherwise, or top dry, eaten by borers, bent and broken by snow, sleet or storms.
3. Take out those that are suppressed beyond recovery, those crowding the more thrifty ones and the large crowned trees that are holding back a strong undergrowth of seedlings, which if given their freedom would soon spring into valuable timber trees.

All of these classes of trees will, for fuel and other common uses, yield a value, if judiciously handled, commensurate with the labor and the investment, besides the satisfaction of carrying forward a systematic, altruistic, aesthetic and valuable work.

When this thinning process has been well executed the stand of trees retained will be of the best quality and the proper quantity for the forest, and the cultivation for its future development will be only the cutting out which becomes necessary to retain it in prime condition. If the stand is thick, a few years growing will require a second thinning which may call for the same or a different plan of operation from the first, of which the owner, if thoroughly in sympathy with retaining his wood lot, will ascertain for himself. For most of the ordinary farm forests the annual demands for fuel and timber for other uses of the farm will cause enough cuttings, if rightly applied, to properly develop the forest to the best stage of value and usefulness, which will be in time from forty to fifty years for large valuable timber. A complete harvest can then be made and the forest again renewed. Mill owners assert that a crop of good saw timber can be cut about every twenty years if the young forest is left to grow after a crop has been cut off. This is asserted by many owners and observers of tracts which were thoroughly cut off for saw timber and per-

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"SEED AND FEEDING"

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to make them valuable. The few
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sitions are such that they would
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tions a sod has formed over the
at sod and forest can not exist at
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renew a wood lot of this type, the
up the spring or fall previous to
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“strip” plan can be used in this
be prepared and planted each year
en gone over. The seeds may be
hich they mature (see discussion of
once on the pulverized soil either in
may be stored till spring and then

ng trees to secure the best results have
the recognized ones are four to eight
row planting, so that cross cultivation
least planting will not bear such close
can not be so assured.

is one which possesses some good forest,
scanty trees with sod formed alternating
In many instances the trees remaining on
of a good kind and can be used as seed
restock, and then removed to let the under-
impered. The “group” system can be used
By this system the good trees are used as
The sod is broken as before described and
ted to fall and become imbedded in the pul-
forth as nature brings them. Effort may be
seeds as far from the trees as the quantity will
tand, or the seeds may be permitted to germin-
the tree and then be transplanted to other
There is seldom a year that such trees do
the sod formed under them prevents the seed
inating hold in the soil, or stock is permitted
destroy the chances of a new growth of trees

PROTECTION OF FORESTS.

Forests are the least protected against damage of any other form of property the owner possesses. Every year there occur in Indiana forest fires in great number. There is not a county in the State that is not the scene of annual forest destruction by fire. The sources of fires are locomotives, careless hunters and neglected brush fires from clearings. In almost every instance the damage is far greater than estimated, if any thought is given to calculating the loss. In most cases no thought is given to the damage and but little effort is made to check the fire unless it promises to extend to other property. The only seeming effort made is to confine it to the forest area and let it burn itself out. If an actual estimate were made of the damage accruing from a medium forest fire it would astonish the owner and reveal to him that the loss of his crops and buildings would not exceed it, and yet he willingly permits it to burn unmolested in his timber and frequently gazes upon it with a pleased mein wholly unconscious of its damaging significance.

The injury done by a forest fire can not be estimated by the value of the trees that die directly, but the injury which is sustained by many that live on after the fire is such that they are made valueless. The fire burning for only a short time in the leaves and humus causes sap boiling wherever the heat comes to any extent in contact with the tree and in a short time the bark dies, falls off and the wood is exposed to die and form a rotten place in which borers and beetles form their attacks upon it. In after years when the tree is cut it is found to be hollow, worm-eaten and generally affected, rendering it of no consequence except for fuel. It is seldom that a sound forest tree is now found, which fact may be traceable to past forest fires. It is sincerely urged that all who are interested in the saving and the promotion of the forests will lend their efforts to guard against forest fires and to enforce the laws against all violations.

Wood lots surrounded by cleared land can easily be protected. If fire should by chance start in them it can promptly be seen and put out. If the forest is subject to danger from fires by its proximity to railroads or similar causes fire lines can be established and retained easily to prevent the fire from spreading



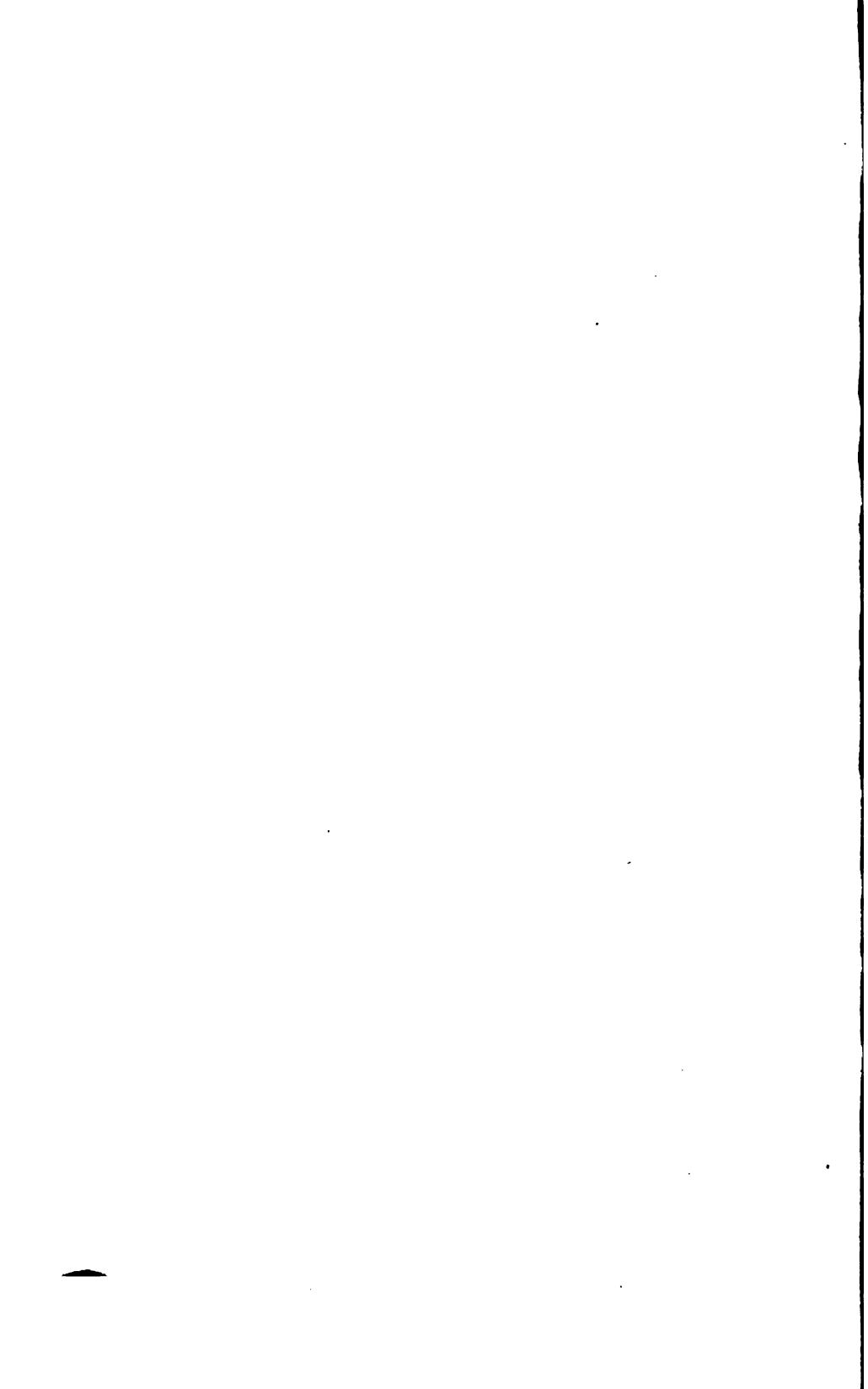
A VIEW OF YOUNG FOREST DEVASTATION BY FIRE WHICH OCCURRED A YEAR AGO THIS LAST
SUMMER ON THE NEW FOREST RESERVATION.

It is estimated that 50,000 young trees were absolutely killed by this negligent fire.



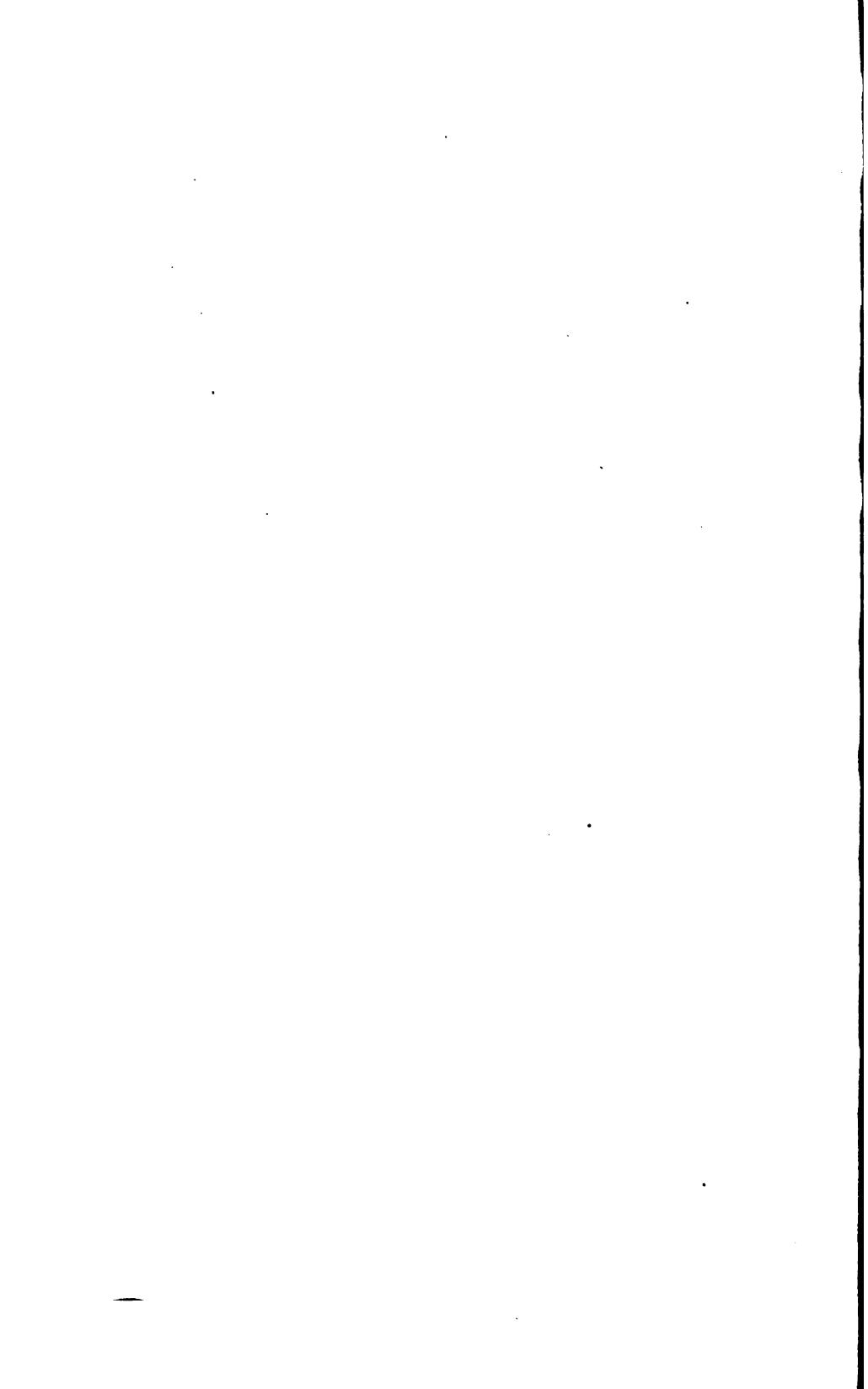


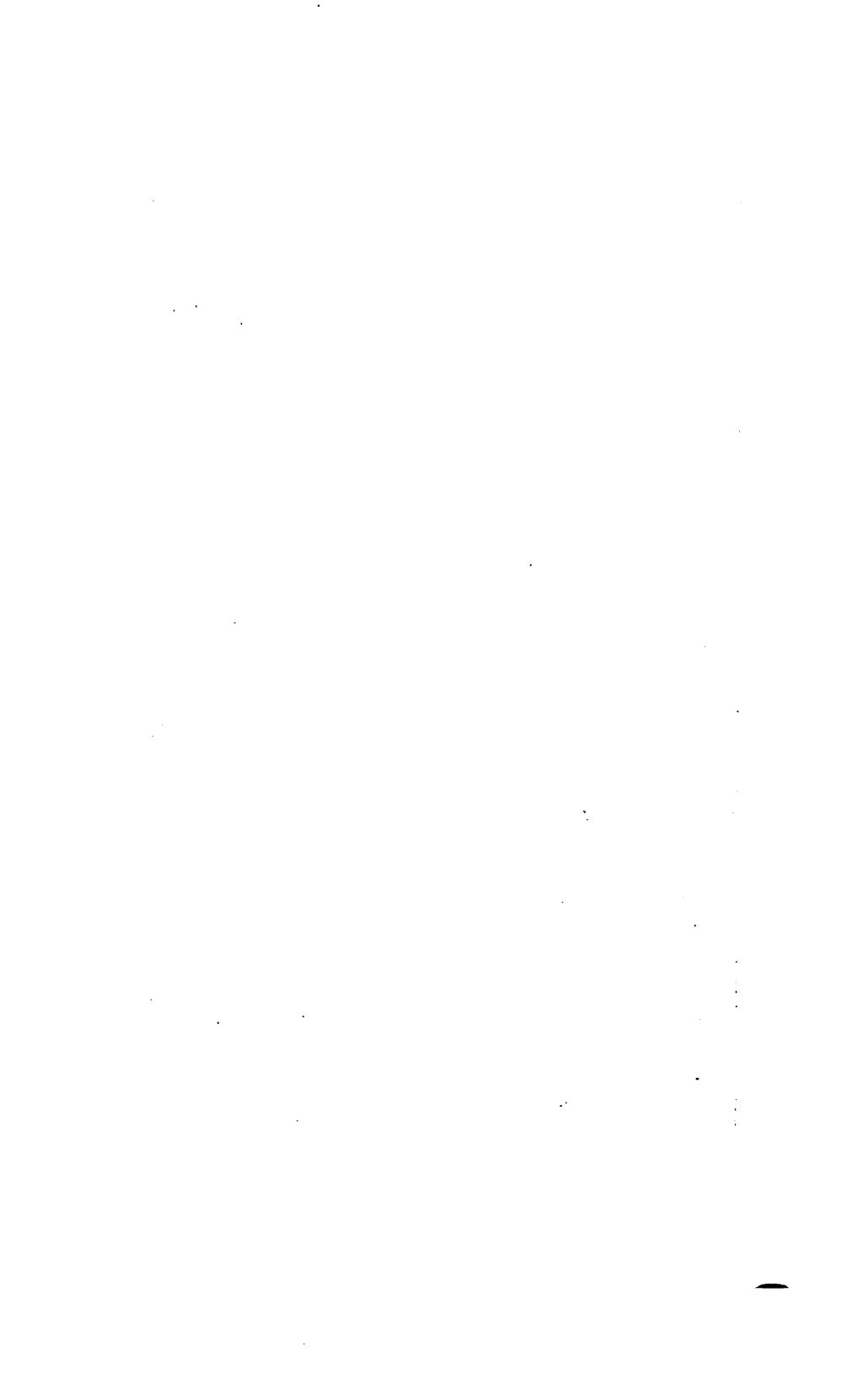
A SUGAR MAPLE SHOWING THE PERMANENT INJURY FROM FIRE BURNING
THROUGH THE LEAVES AND CAUSING SAP BOILING AND
THE ATTEMPT TO HEAL OVER.



beyond the limit. Strips on the danger points can be cleared of leaves, and rubbish, which will prevent progress. Regular lines may be made for such purposes and kept plowed up during the danger season. In case fire breaks out and no fire lines exist to check it, the thing to do is to make such lines at once and in such places as will check the fire from spreading. If no water is available to put out the fire, fresh dirt thrown into it will readily put it out. Back firing can be done to head off a fire where the means described can not be used. Judgment will reveal many simple ways to stop a forest fire without letting it burn itself out.

Young trees should be protected against stock, which browse upon them, gnaw the bark from the trunks, bend, break down, and otherwise destroy them. A forest can not be successfully renewed if stock is permitted to pasture therein until the stand is above their harm.



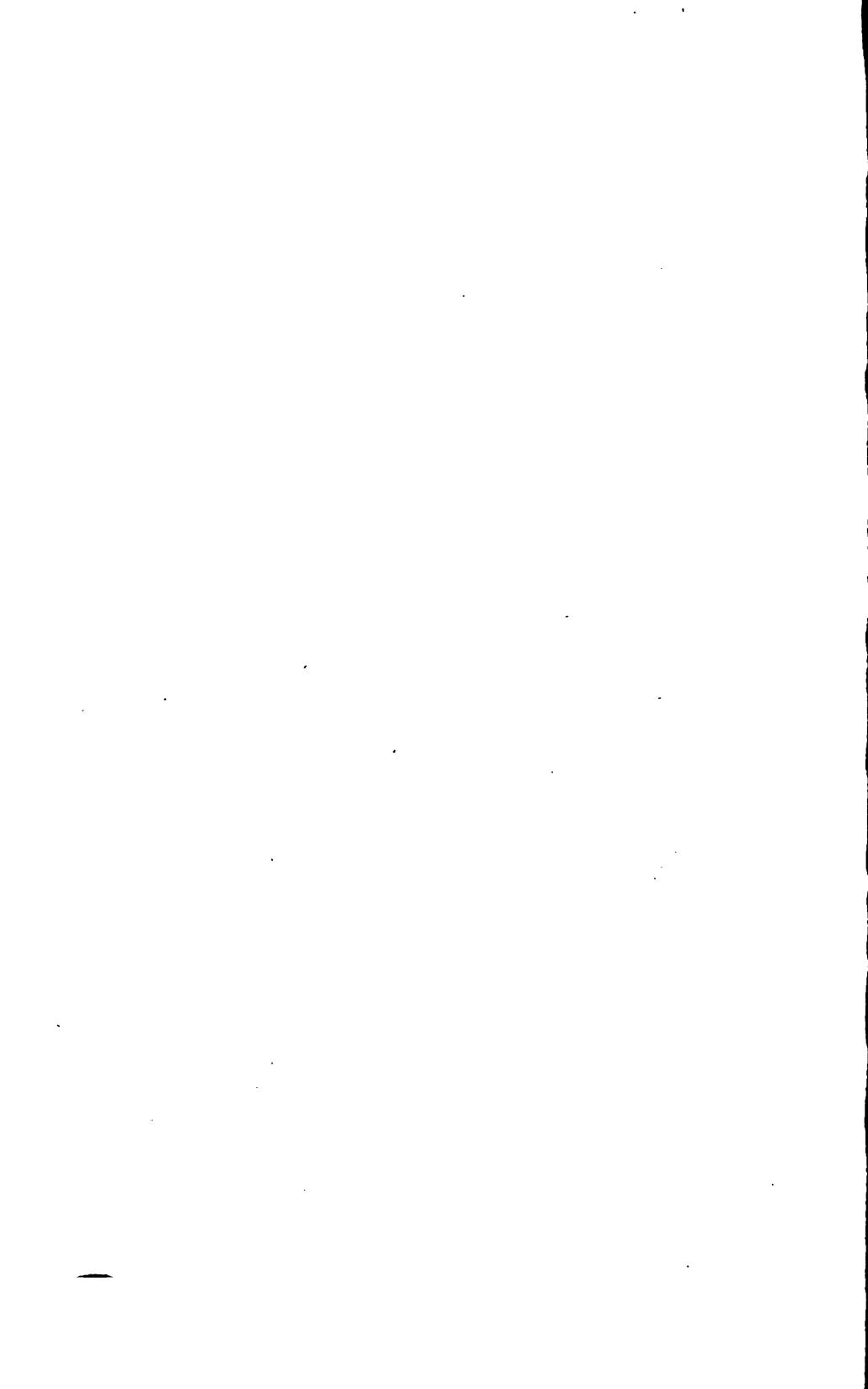


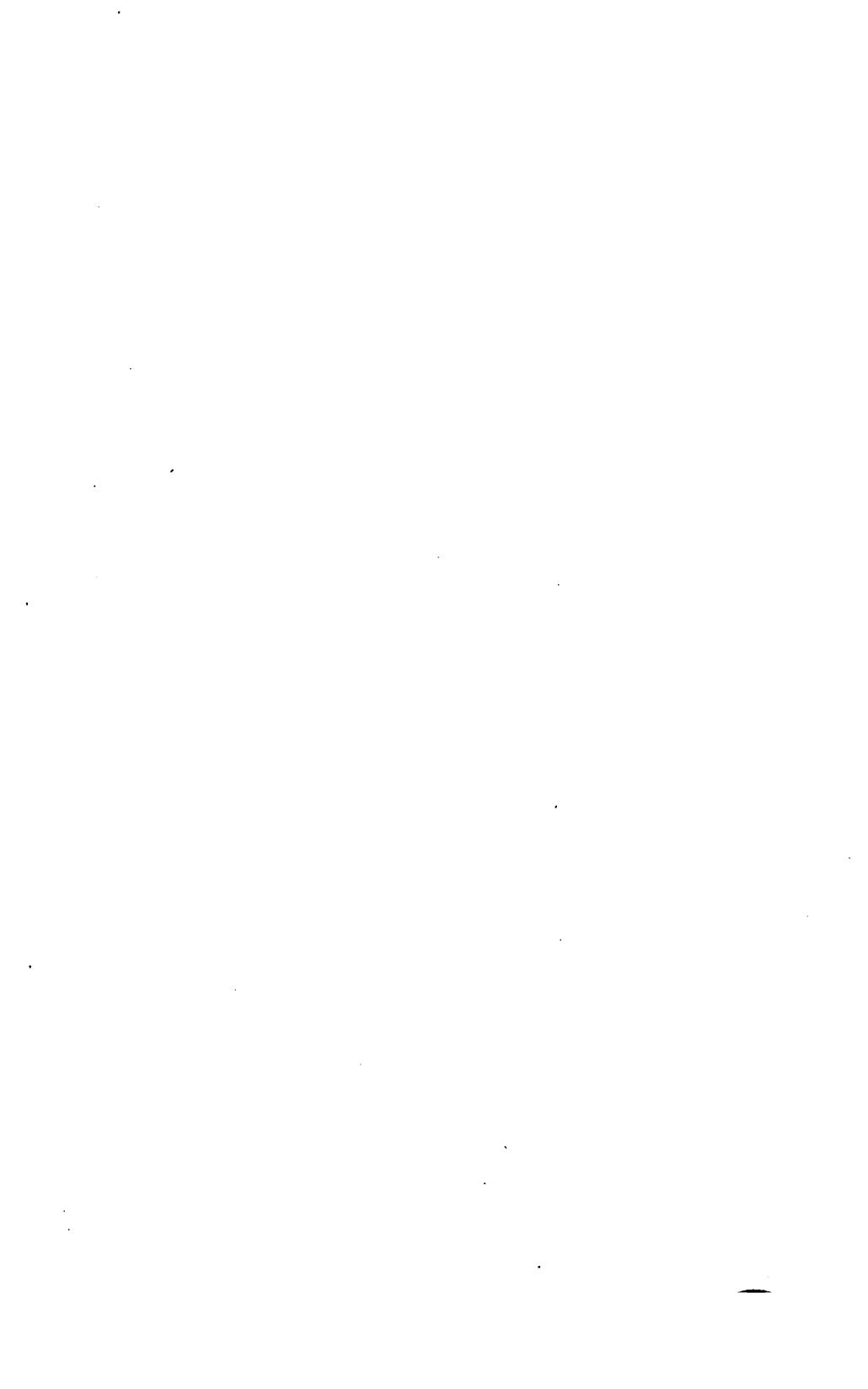


A VIEW OF FIRE INJURY BY BURNING BRUSH IN A FOREST, A THING WHICH SHOULD NEVER BE PERMITTED.



A VIEW OF THE INJURY OCCURRING TO A YOUNG POPLAR BY FIRE BURNING THROUGH THE FOREST LEAVES AND CAUSING SAP BOILING.





SOME TREES TO PLANT FOR RAILROAD TIES, FENCE POSTS AND LINE CONSTRUCTION POLES.

The kinds of timber which have been almost exclusively used for these purposes is rapidly becoming exhausted, and an effort must be made to meet the future demands by growing them under cultivation. Farmers are finding difficulty in securing good fence-posts at reasonable prices, railroad companies are resorting to inferior grades of timber and treating them chemically to supply them with crossties, and line construction companies are compelled to pay fancy prices for poles used in telephone and telegraph line building, and every sign indicates that the demand will be larger as years pass. Farmers can meet these demands at good profit by cultivating a part of their land to timbers suited for these uses.

The trees given here are some of the best for these uses and are all rapid growers.

CHESTNUT.

The natural range of the chestnut is from southern Maine to the Gulf of Mexico. It thrives well throughout the Mississippi Valley.

The soil best suited for the growth of the chestnut is retentive clay containing some sand or at least porous. It does not demand a rich soil and does excellently on old, abandoned fields. The chestnut will endure the heat and cold of the temperate climate and will grow very well in sunny, dry situations.

The wood of the chestnut is light, strong, coarse-grained and inflexible. It splits very readily and is exceedingly durable in contact with the soil. It is used in cabinetmaking and for interior finish. In all sections of the country it is prized very highly for use as railroad ties and telegraph poles. It makes very durable posts, and is also valuable for shingles. Its rapid growth and tendency to reproduce by coppice make it a valuable tree for these uses. The chestnut grows very rapidly on good situations. The trunk of the tree grows tall, tapering, and free from limbs.

The chestnut reproduces from seed and from sprouting from the stumps after cutting off. The growth from stumps with good

root systems is very rapid, and cuttings can be made about every twelve years. The seeds ripen at the time indicated in a preceding article and they may be planted as soon as mature or may be stored and planted in the spring. It can be grown well from seedlings, as they bear transplanting successfully. The best distances to plant are 4x4 feet or 6x3 feet.

I consider this one of the finest trees for farmers to plant, because of its clean nature, lasting qualities for all the uses given and its ease of cultivation. The trees should be pruned when young to form the correct boles.

CATALPA.

The Catalpa Speciosa occurs naturally on the deep, fertile soils of the valleys of southern Indiana, Illinois, western Kentucky, Tennessee, southeastern Missouri, northern Mississippi, Louisiana and northeastern Texas. In the most favored localities it attains a height of from 60 to 80 feet, occasionally reaching 100 feet. The diameters range from 2 to 4 feet. This has proven to be a valuable tree, hence at the present time has become exhausted along with the other valuable kinds, so that now it is rare that a fine tree can be found. It is capable of a much more extended range than is given it. It has been successfully propagated as far north as 41^o latitude and as far west as 100^o longitude. I do not believe that there is another tree capable of stronger soil adaptation than the catalpa. It is especially adaptable to deep, fertile, porous soils, and thrives well when there is an underflow of water within 10 or 12 feet of the surface, even in slight rainfall. Because of these attributes it is successful throughout Indiana, with the exceptions of the stiff, clay soils, and a mistake will be made if it is planted on such soils, no matter how much attention and care may be given it.

The catalpa is a rapidly growing tree, when congenially located, for a period of 50 years and more. From 15 to 25 years are required to grow trees suitable in size for telegraph poles and railroad cross-ties, while for fence posts from 8 to 12 years are required. Plantations favorably located have returned great profit. Some of the following are instances of the returns: The George M. Munger plantation, Eureka, Kansas, averaged at 13 years a net

annual profit per acre of \$15.01; the H. H. Hunnewell plantation, Crawford County, Kansas, averaged at 18 years a net profit per acre of \$26.47; the L. W. Yaggy plantation, Hutchinson, Kansas, averaged at 12 years a net annual profit per acre of \$21.55. In all these instances the stock for planting was purchased, the planting was cultivated for two years and paid for. Every expense, including 6 per cent. interest on the investment was counted and deducted from the gross earnings.

It is most readily propagated from seed sown in the nursery in the early spring. The seed can be easily obtained from seedsmen. They ripen in October and can be gathered and safely kept through the winter in a cool, dry place. The nursery site should be of rich, mellow soil finely pulverized. The nursery rows should be for hand cultivation, 18 inches apart, but for horse cultivation they should be 3 feet apart. If the proper attention is given the nursery, the seedlings will be sufficient size for planting the following spring. Owing to the fact that it is difficult to grow the catalpa with straight boles, extra caution must be taken to force the right form of trunk. It should be planted at distances of 4 by 4 feet or 6 by 3 feet, and not to exceed 5 by 5 feet under the most favorable conditions. The tendency of the catalpa seems to be to branch and crook in growing. If it is planted closely, the lateral branches die before they attain any size and are easily pushed off without causing any damage, but otherwise they remain and cause permanent damage to the body of the tree. New wood is formed around the branch and thus leaves a hole into which water is conducted and the tree becomes affected by rot in the heartwood. In addition the close planting causes them to grow up in search of light and thus checks the tendency to crook. The difficulty to straight trunks is the serious drawback to the catalpa. The surest method for overcoming this evil is to cut the trees back to the ground at the end of two or three seasons' growth. The extensive root system formed will cause vigorous sprouts to put up from the stump. In midsummer following the cutting back, they should all be removed but the one most thrifty, which if left is soon forced upward in a long straight bole, free from the numerous branching. At the end of the same time a great advantage is gained by doing this, though it may appear like destroying the two or three years'

—Forestry.

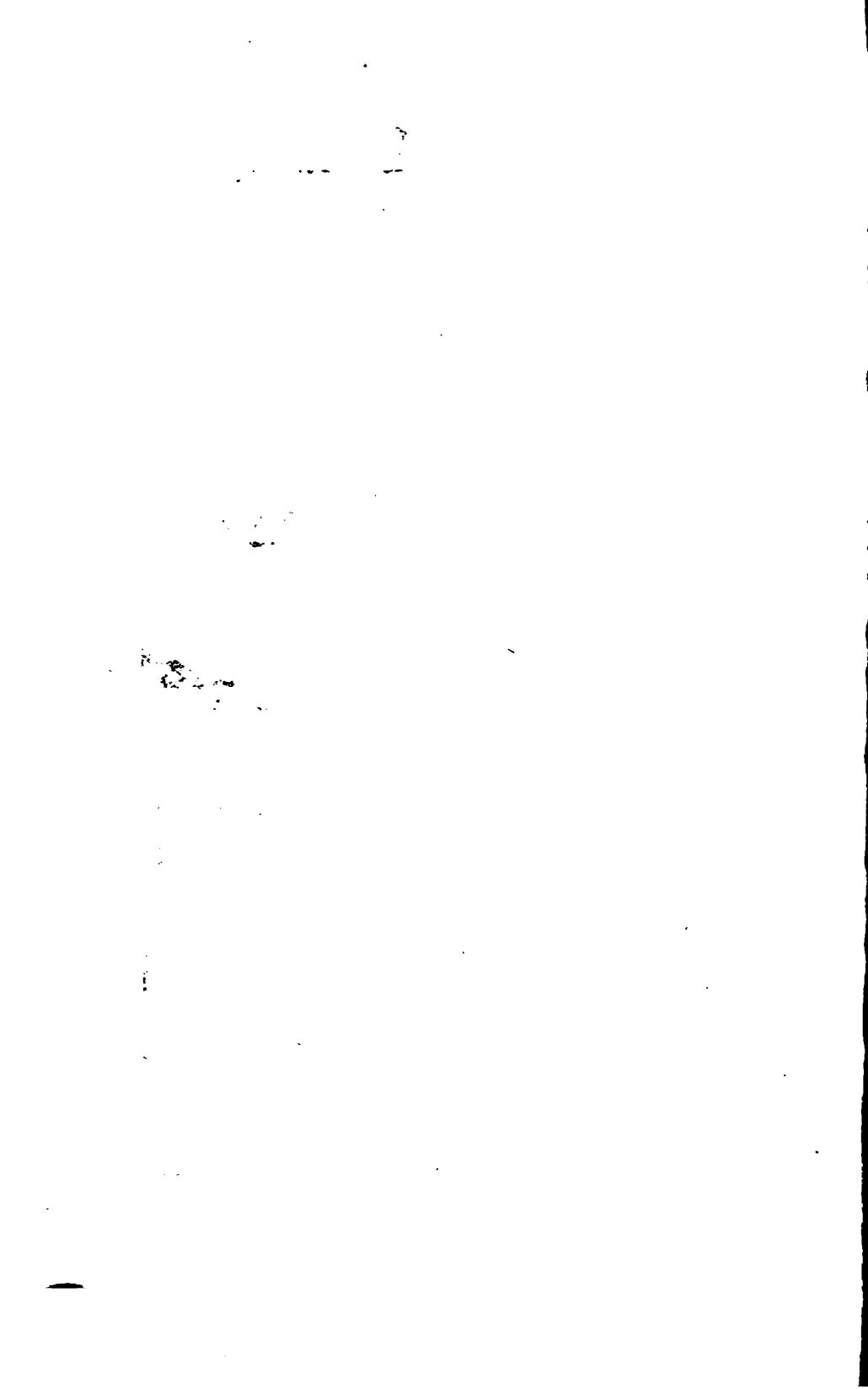


A FIVE YEAR OLD CATALPA FOREST AT BRIGHTWOOD, INDIANA.

Showing the trunk forms when not cut back for sprouting. These trees were planted at too great distances, eight and ten feet.



THE FIVE YEAR OLD CATALPA FOREST AT BRIGHTWOOD, INDIANA.
Showing the sprout formed at the end of the first season's growth after being cut
back to the ground.



growth. It can be grown successfully in pure or mixed plantings with the walnut, locust, ash or Kentucky coffee tree. In case planters do not care to grow seedlings for planting, there are nurseries throughout the West which grow them for wholesale plantings at very small cost per thousand.

There is difficulty in planting the catalpa by not being able to distinguish the varieties. There are at least four different species, two being shrubs and two fully developed trees. The War-de-r Speciosa or hardy catalpa can be distinguished as follows: The leaves are from 5 to 12 inches long, heart shaped, long pointed; the flowers are about 2 inches long, nearly white, faintly spotted, the lower lobes somewhat notched; the bark is rough and thick. The other species (*Catalpa Bignonioides*) which is also a large tree, has about the same shaped leaf, but has sealy glands in the axils of the large veins on the under side, entire, usually, angulated, opposite and sometimes in groups of threes, very downy beneath when young; the flowers are much spotted with yellow and purple and with the lower lobe entire; the pod is long and thin; the bark is lighter in color and not so rough and is thin. The other kinds are mere shrubs and at no time could be mistaken for the larger kinds. The former one is the tree to plant for economic uses, though the other kind will give fair returns in durability.

There are two forms of disease which infect the catalpa, the wood rot and the leaf blight. The wood rot may be classed into kinds, the soft and the brown rots. Both are caused by the decay of limbs which are left on the tree till growth takes place around them thereby leaving holes into which water is conducted as heretofore mentioned. The remedy is to prevent any such conditions by pruning and daubing over the cuts so that fungi spores can not get in to form such rot. Right planting, pruning and treatment by daubing the cuts made will avoid such difficulties. The blight of the leaves is due to the larvae of *Diplosis*, a gall-gnat. The affection is evident by the leaves, shoots and buds turning black, shriveling and dying. Trees which are affected several years in succession show the effects by the numerous sprouting of limbs and trunks. No good remedy is known at present.

KENTUCKY COFFEE TREE.

(Gymnocladus dioicus.)

The natural range of the Kentucky coffee tree is the northern two-thirds of the Mississippi Valley. This is one of the rarest trees of North American forests. Its range for economic planting is coincident with its natural range. It should be planted much more frequently in the future than in the past. In barren soil, it is a slow-growing, long-lived tree. In fertile river valleys it grows more rapidly. It produces the best results on the richest bottom lands, but will thrive on sandy or gravelly uplands. This tree will endure the most extremes of climate.

The wood is heavy, moderately hard, coarse-grained, strong, and very durable in contact with the soil. The sapwood is thin and the heartwood of a rich, reddish-brown color, is very suitable for cabinet work and interior finish. The timber is but little known at present.

The Kentucky coffee tree sometimes attains a height of 100 feet and a diameter of 3 feet, but it is usually much smaller. The trunk usually possesses a very uniform thickness and is tall and free from limbs.

This tree reproduces from seeds which are borne in pods by the pistillate individuals in great abundance. In starting a forest plantation of this species, it is much better to plant the seeds in nursery rows and transplant the trees into the final forest site at the end of one year than to attempt to grow the trees from seeds planted in the permanent site. The Kentucky coffee tree develops a root system which adapts it to transplanting.

The pods should be collected in the late fall and macerated in water to remove the seeds. After the seeds have been separated from the pods and dried reasonably, should be stored in sand to weather.

The rules for planting the coffee tree are the same as for the locust and chestnut.

The Kentucky coffee tree is a light-demanding species. It can not keep the grasses and weeds in subjection when planted alone, owing to the open nature of the foliage and to its habit of leafing out very late in the spring. In nature it grows associated with the ash, walnut, hickory and elm. When making a forest plantation

of this species it should be mixed with such trees as the white elm, red elm, hackberry, oaks and ashes. If planted several years previous to its associates, it may be mixed with hardy catalpa, Russian mulberry or black locust. The growth and habits of this tree in the Southwest are very similar to those of the walnut. It can be substituted for the walnut in almost any planting or use.

BLACK LOCUST.

The black locust was originally indigenous in the mountainous regions from Pennsylvania to Georgia, and occasionally Arkansas and eastern Indian Territory. But at the present time, through cultivation and other agencies, it has become naturalized throughout the United States east of the Rocky Mountains. It is appearing naturally abundant upon abandoned hillsides in the states of Pennsylvania, Ohio, Indiana, Kentucky and in the southern portion of the plains west of the Mississippi to the mountain slopes. It is associated with other deciduous trees in the form of small scattered groves.

There is an objection offered against the black locust on account of its sprouting and spreading tendencies from the root. I do not consider this a sufficient cause to militate against the planting of this tree for economic purposes. A casual observation will convince that most any tree does equally as bad, but nevertheless caution should be taken to confine it where planted. The seeds should not be allowed to become scattered over the farm by being hauled out in the manure or otherwise. A row of osage, soft maples or other dense shading trees planted around the locust planting will prevent spreading.

The growth of this tree is very rapid in all rich, loose soils. It attains its maturity at about 50 years and the usual size is about 80 feet in height and from 2 to 3 feet in diameter, depending largely on the distances planted as to its trunk formation. The largest and quickest matured specimens are found in deep, loose clay, valley and bottom-land soils, though it grows successfully on poor soils if sandy or gravelly, and it is shown to be the most durable wood when grown on such lands. The locust should never be planted in hard, wet, clay soils as its roots are surface spreading and draw nourishment from the surface and hence in such soils can not penetrate sufficiently to insure a good strong growth.

The black locust is finding extensive use for posts, ties, telegraph poles and vehicle manufacture. Its great durability in contact with the soil, its toughness and elasticity of fiber make it valuable for these uses. A post from 6 to 8 inches in diameter can be grown in from 10 to 12 years in good soil. Unlike many other timbers, the young wood is almost as durable as the old. Posts of such character last from 12 to 20 years, though extremists say much longer. This tree is a most valuable one for fuel planting.

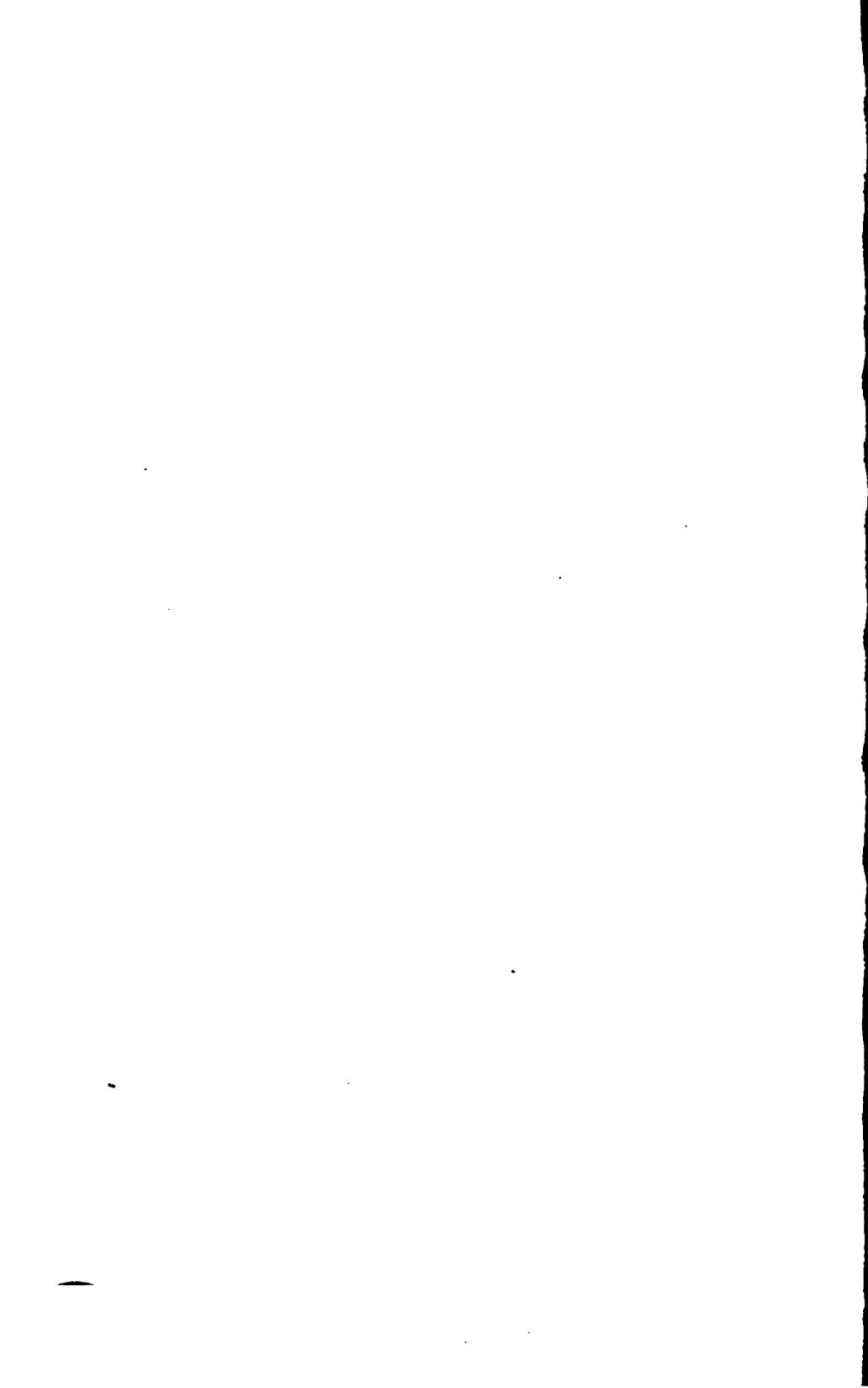
The planting, to secure good results, should be close, 4 by 4 feet or 3 by 6 feet. They should be pruned when young to aid in forming, straight, long boles. Every effort should be made to keep the trees thrifty and growing, to prevent attacks from borers. To this end the grass and weeds should be kept out till the growth is large enough to protect itself. The planting should be watched to make trimmings at the proper times to prevent the decay and injury by crowding and smothering. A thrifty growth is seldom attacked by borers. The locust grows well in mixture with the catalpa, elm, ash and walnut.

The black locust is propagated from seeds and root cuttings. The seeds retain vitality for years if kept in the pods or buried deep in the ground, 7 years having been known to find good vitality remaining. The seeds ripen in July and August and may be planted at once or kept in storage till spring and then sown in nursery rows. The seedlings should be propagated in the nursery bed and transplanted to the permanent places in the plantation the following fall or spring. If the nursery is to be cultivated by hand the rows should be from 15 to 18 inches apart, but if by horse cultivation the rows should be $3\frac{1}{2}$ to 4 feet apart. A pound of seed contains about 2,800 in number and is sufficient for a row of nursery 900 feet long. The nursery site should be in rich, pulverized loam. To secure the best degree of seed germination the same year they are planted they should be treated to soften the stone shell of the seeds. The seed should be removed from the pods and kept stored by placing in boxes, stratified in layers of sand, kept moist during the winter until time to plant. They may be placed in a box or bag and buried in the ground so that water will not settle upon them, and let them remain until time to plant in the spring. Freezing and thawing will add benefit to the result.



FOUR YEAR OLD BLACK LOCUST FOREST OF ROBERT MAXWELL, MARTINSVILLE, INDIANA.

These trees were planted on a rolling porous, sandy clay slope at distances of six feet apart and were never cultivated except pruning the past summer.



Nursery-grown seedlings can be secured at very low cost per thousand from reliable firms engaged in growing forest tree stock for wholesale planting. Any seed firm can secure the seed for its patrons.

I do not anticipate that there are many who do not distinguish the black from the honey locust, but I have frequent enquiry concerning the differences of these two trees. In short the characteristic differences by which they may be known are as follows: The black locust has reddish-brown, rough bark, broken in ridges; the leaves are compound, alternate, rounded at both ends, entire netted-veined, occasionally tipped with the end of the midrib and covered with silvery short hairs when young; the flowers are white, fragrant, and in loose axillary racemes; the seedpods are linear, smooth, short, contain from 4 to 6 brown seeds and hang on the tree over the winter. The honey locust has rough, gray bark broken into scales at the base of the trunk; the young branchlets are a deep reddish-brown; the leaves are compound, alternate with long, downy leaf stalk, smooth, green above, yellow below and from ten to twenty long oblong leaflets tapering towards the apex and rounded at the base; the flowers are greenish white and grow in narrow racemes; the seed pods are from 9 to 20 inches long, reddish-brown, flat, linear, curved, contain between the seeds a sweet substance and seldom hang on the tree during the winter.

The honey locust is usually very thorny, while such is seldom the case with the black locust.

OSAGE ORANGE.

The osage orange thrives well throughout the same range as the chestnut, though it has been more widely introduced by cultivation. The soil best suited to its growth is deep, rich, clay loam, retentive of moisture.

It has been extensively planted for hedge throughout the Central States, but it should be more frequently planted as a timber tree. It sometimes gets winter killed in the northern part of this State.

The growth of the osage for the first few years is very rapid. It never makes a large tree, and matures in a reasonable period of time. The tree when standing alone has a tendency to branch very profusely. It is this habit which renders it of such great

value as a hedge plant. If crowded, it can be made to grow into a form which adapts it for posts. The osage orange reproduces by sprouting from the stumps, from the roots and from seeds, which are borne in great abundance by the pistillate individuals. The ripe fruit containing the seed is a fleshy, globular, yellow mass with roughened surface, somewhat resembling an orange. The fruit should be collected in the fall as soon as ripe, macerated and the seeds washed out and stored in sand. Seedlings of this tree can be bought cheaper than any other kinds from nursery firms.

A good method of planting the seed is in the bottom of a furrow made by a plow. They should be covered about an inch and a half deep. The seeds may be planted where the trees are intended to stand, or they may be planted in a nursery and the trees transplanted to their final site at the end of one year. The right distances of planting are same as the chestnut.

The osage orange reproduces from coppice very readily. This quality allows the planter to continue to take successive crops of posts from the same plantation for years. The young shoots grow up from the stump with such vigor that the second crop is more likely to consist of straight, smooth post timber than the first crop.

The osage orange is a shade enduring tree. The thorns of the tree make it often undesirable to plant. The osage orange does well in either pure or mixed plantations. In this way thick planting may be practiced and the need of inner tillage reduced to a minimum.

BLACK WALNUT.

The range of the black walnut is west from Massachusetts to Kansas and south to Florida and Texas, covering practically the middle Atlantic, Central, Southern and a portion of the New England States. It was formerly abundant throughout this range, and is undoubtedly a sure tree for economic and commercial plantings in the Mississippi Valley from Minnesota southward. The soil best adapted to the growth of the walnut is fertile alluvium containing large quantities of humus. It thrives best in porous, open subsoil, such as is found in low river bottoms. The walnut is subject to injury by exposure to hot winds and extreme cold,

therefore, some judgment should be exercised before planting it in the northern, southern and western ranges, though any part of Indiana, climatically, is free from such influences.

The wood of the black walnut is rather heavy, hard, strong, rich dark brown color and easily worked, hence highly prized in fine finish and cabinet making. It is also a lasting timber in contact with the soil. The walnut is a rapid growing tree in good soil. At maturity it attains a diameter ranging from 4 to 6 feet and an average height of nearly 100 feet. No other tree excels it in clear straight trunk when planted in close proximity, 4 by 4 feet or 6 by 3 feet. The walnut matures to good value in 20 years, though the best value is not below 40 or 50 years. It grows rapidly for the first twenty years, but a great amount is sapwood, but from then on the growth is slower because the sapwood is transforming into heartwood and the older the tree becomes the more valuable it is. No walnut plantings have been made and harvested from which to estimate the value per acre to the planter, but from all theory involved it surely is a safe financial enterprise.

The walnut is best propagated from the seed planted in the fall of the year and stored by stratifying in the ground or in dampened sand in boxes till spring, and then planted. The stratification should be where the seeds may be exposed to freezing and thawing in order to soften the stone shell and insure quick germination. It will do well in mixed plantings with the elm, oak, ash, hickory, locust, poplar and maple, if care is exercised to prevent its being shaded out or overtapped. When planted at the distances indicated above and thinnings properly made to secure thrifty growth, I feel confident of the financial success of the walnut planting.

WILD CHERRY:

The range of natural growth for the wild black cherry is from Nova Scotia westward to the Great Lakes and to the Dakotas and south to Florida and Texas. It, like the black walnut, thrives best in the middle Atlantic and Central groups of States, but is not found so abundantly in the open prairie. In the dense forest regions of the natural range the cherry was formerly a conspicuous part of the forest growing on the rich soils, but like the other valuable hardwoods it has been sought to the almost complete exhaus-

tion of the valuable trees at the present; especially is this so in Indiana.

The range of the economic planting of the wild cherry is extensive, though nowhere is it surer of successful propagation than in Indiana, but seeds and seedlings of southern acclimation will not thrive in northern latitudes. Such, however, is not the case with seeds and seedlings northern acclimated. By observing this caution, the bad winter killing of many wild cherry economic plantings of northern sections can be obviated.

The wild cherry is a rapidly growing tree, though short-lived, hence a splendid tree to plant in mixture where thinnings are necessary to make room for the expansion of the longer-lived kinds. In timber regions it grows to considerable size, forming a long symmetrical trunk, making it a valuable tree for saw and veneer mill purposes. In economic plantings it should be planted at close distances, 4 by 4 feet or 6 by 3 feet, in order to force a long bole, and then many thinnings for the expansion of the remaining trees. The wood of the cherry is a reddish-brown color, hard, fine-grained, durable, strong, heavy and takes on a fine satiny polish. Because of these qualities it is sought for fine interior finish and cabinet-making.

This tree propagates readily from the seeds which may be sown as soon as ripe in the fall, or they may be stratified and allowed to freeze during the winter. The manner of stratification is the same as indicated in the discourse on the black walnut. The seeds can be planted in the site where the tree is to grow, or they may be planted in nursery rows and transplanted to the permanent sites when the seedlings are one or two years old. I recommend the storage process for the seeds and the nursery planting as against the direct planting of the seeds in the permanent sites. It is a light demanding tree, therefore should not be planted in mixture with trees that will outgrow and overshade it. It can be safely planted with elm, walnut, locust, birch and ash.

SEEDS AND SEEDLINGS FOR FOREST PLANTING.

The planting of new forests is a thing which will greatly concern the people of Indiana in the very near future. Without doubt it will command much attention in certain parts of the State where the conditions are better adapted to timber culture than most any other thing in which the people might engage. There may be many ways in which such work may be performed, but the simplest and most effective methods of planting from seeds and by homegrown nursery seedlings is recommended as giving the most satisfaction. These methods are inexpensive, and make planting possible on a large scale with small means. The following discussions may suggest some things of value to guide those who wish to engage in planting.

SEEDS.

It is very important to procure and use only good seeds in planting. This is essential to secure a stand and to prevent a waste of time and labor. The quality of seed depends largely on its being perfectly matured, the size, the age and the location in which grown.

In the instance of one and the same species of seed, the larger, heavier and mature ones are better than the smaller weakly ones. None but the former should ever be selected, because they possess greater germinating power, are more vigorous against hindering conditions of every sort. They have a greater reserve of material to aid development, the same as good seed of wheat, corn or any other agricultural product. This fact may be traced on through the life history of the tree from such seed. In cases of tests the dominant tree grew from the perfect seed.

The quality of seeds can sometimes be tested by the external appearance, but not always. Good seeds fill entirely the outer shell, are of a live, rich color and smell strongly of the characteristic odor of the tree. In all cases of heavy seeds, where it is not desired to trust to the senses of touch, sight and smell, they may be tested by throwing them into vessels of water, when the well-developed seeds will sink and the inferior ones will float.

The germinating power of seeds is greatest just when it has ripened. It may be retained for a time, according to the species, and in case of proper treatment can be retained in perfect vigor. Some seeds must be planted immediately upon maturing, while others can be kept for some months. It is well known from natural information that all seeds ripening in the autumn do not germinate till the next season. Under favorable conditions the seed may be planted in the fall as soon as they mature, but owing to climatic uncertainties it is better to store and plant in the spring. The best time for planting in the temperate climates is April and May.

That the late maturing seeds may be kept in good condition, they should be properly treated and stored through the winter by either the earth or cool dry processes, according to the requirements of the seeds. The nuts and acorns should be divested of the hulls and cups, the cones and pods should be dried and the seeds whipped out, or the seeds may be allowed to remain in them, and the fruits should be macerated and the seeds washed out. All those requiring earth storage should be reasonably cured in the open air and light (never by fire heat), and then stored.

The manner of storing in earth is very simple. Select a well drained site and excavate to a depth of eight or ten inches, and as large as required for the quantity of seeds. Place within the excavation alternately layers of seed and earth till all are stored, cover to a depth of five or six inches with dirt, arrange the drainage so no water will stand on the seeds, and let them alone to freeze and rot till time to plant in the spring. To store in boxes is very similar. Secure boxes of such size as are needed to hold the quantity of seeds in storage, fill the boxes with sand and seeds in alternate layers, bury the box in the soil on a well drained site as in the former case and let remain till time to plant. Another method is to arrange plank boxes on the surface and store the seeds in either earth or sand as before and allow them to remain till spring. It will be found necessary to guard against rodents destroying seeds in storage as well as after planting.

When seeds are treated in the ways thus described, and if no water is permitted to stand on them, the weathering thus afforded them is the thing they need to soften the shells and insure prompt

germination when planted. When the seeds are removed from earth storage they must be planted at once and not allowed to dry out, as that will destroy the life germ.

The trees the seeds of which ripen from September to November, inclusive, and need earth storage, are the following: Oak, hickory, ash, walnut, sugar maple, locust, chestnut, plum, cherry, persimmon, dogwood, hackberry, beech, lin, osage orange, and black gum. The trees the seeds of which ripen from August to November, inclusive, and need storage in a cool, dry, airy room are the following: Canoe and sweet birches, catalpa, sassafras, mulberry, sweet gum, poplar, cottonwood, cypress and pine. Those the seeds of which ripen in May and June, and must be planted at once, are the following: Elm, red birch, red maple, and ironwood.

The trees from which seed should be gathered and the locality are two matters which should be considered. Though all aged trees may and can yield good seed as a rule, it is better to select seed from trees which are in the prime and vigor of growth and possessing full crowns. The seeds should be selected from a locality of the same soil and climate as the area to be planted, say some authorities, while others disclaim the idea and think that the same thing prevails in this as does for seed in agriculture, and that different soils and climate should be considered in seed selection. Seeds should be secured which are good and thrifty and from trees sound and in the best growing state, and I am of the opinion that the other facts will not count for much, though with the buying of seedlings it would be quite different.

The trees best to gather from, both for good seed and convenience, are those growing in the open. The seeds of the extreme early and late ripenings should not be gathered, but the middle maturing should be selected. The tree should not be cut to secure the seeds, but shake them down and let the tree remain.

When the right season and conditions of spring come for planting, the seeds can be removed from the storage and thrown into vessels of water to clean them and detect the bad seed before planting. The storing process usually reveals the inferior seeds by their decayed and black appearance from the freezing and rotting effects of the storage. If the seed are to be planted in a

home nursery to grow seedlings for transplanting, the nursery site should be selected and prepared for the seed before they are taken from storage.

THE NURSERY.

The site for the nursery should be a well drained and protected, though not heavily shaded spot, and of good, heavy, rich soil. The ground should be well broken up the season prior to planting, and the process repeated at the time of planting. The soil for the nursery should be thoroughly pulverized. If the nursery is to be a small one for hand cultivation it may be plotted into compartments for different kinds of seeds and for conducting areas of transplanted trees for larger ornamental plantings. The compartments may be made into raised beds or left at a level, just as the owner determines, and may be made of sizes suited to the cultivation. The rows for hand culture may be made from 18 to 24 or 30 inches wide, though for hoe culture the distances need to be very much less than for horse and plow cultivation. The furrows for the seed may be made with any device that will answer the purpose. The seed in the rows should be planted at a distance of about two inches apart and should be covered with fine soil to a depth of about twice as deep as the seed is thick, and the dirt thoroughly packed upon them. Do not do this when the soil is likely to bake very hard. Broadcast planting may be done instead of rows if desired, though because cultivation can not be given the young trees it is not as successful as the former.

If the nursery is to be of considerable proportions, the rows should be made from three to four feet apart that they may be cultivated with the plow and horse.

For extensive forest planting the seedlings should be transplanted at the end of the second year, and those having grown best may be transplanted at the end of the first year to the forest. By transplanting at these ages all the labor, digging and planting, can be performed at much advantage over larger trees. Trees which are retained in the nursery for larger size to be planted for ornament should be transplanted at least twice at intervals of two or three years. In transplanting the roots will necessarily be pruned, as will also the top, as both should always be kept in proportion, and this will cause a numerous fibrous root forma-

tion which insures better success in living when the tree is finally planted to the permanent place.

If the seeds are to be planted directly to the area intended for the forest and in the places where they will be left to grow into trees without transplanting, then the soil must be prepared to receive them.

SOIL PREPARATION.

The preparation of soil for forest planting has been treated under the topic, "Regenerating the Farm Forest," but a better discussion here will not be amiss. Cleared land is prepared for receiving the seeds in just the same manner it is for corn planting. It is well broken, pulverized and marked off into rows either one or both ways, as desired, though it should be marked both ways to admit of cross cultivation. (The distances apart at which the rows should be made is a matter not yet satisfactorily determined, but the usual distances are from four to six feet.) The seed are then planted in the checks and covered. This may be accomplished in any manner found best and convenient. After planting, the soil should be packed thoroughly by rolling it. Any soil that will admit of this manner of preparation should receive it. If the surface is such that it can not be thus treated, the seeds will have to be planted by any means to get them into the earth and sufficiently covered. A hoe, mattock, dibble, circular spade or pick may be found serviceable means. An apron sack may be made to carry the seeds by the planter.

The number of seeds to plant in a hill will depend on the character of the seed. Fifty per cent. is considered a good average for forest seed germination. If the seeds are carefully selected and stored a larger per cent. may be obtained; but under all conditions two to the hill should be planted, and if they germinate well it is better to have to thin than to replant. A good stand should always be the aim. The thinnings can be used to transplant elsewhere.

It is advisable with certain trees to at all times plant the seed in the place where the tree is to grow permanently, while with others it is better to grow the seedlings in the nursery and transplant, and still others are better grown from cuttings. The trees,

the seed of which should always be planted in the permanent place where the tree is to grow, are: Oak, hickory, walnut, chestnut, beech and sugar maple, though they can be transplanted at an early age with a little success. All others can be successfully transplanted from seedlings, especially when young and the conditions are anything like favorable. The poplars, willows and aspens are best grown from cuttings.

FOREST TREE CUTTINGS.

The time to make the cuttings is any time between the sap's going down in the fall and its coming up in the spring. The particularly best time is February and March. The cuttings should be made from one- and two-year-old growths of branches and ranging from one-quarter to one-half inch in diameter.

A convenient length for cuttings is eight to twelve inches. The cutting should be done with a fine sharp instrument, so as not to split the wood. The cuttings should be tied in bundles of fifty to one hundred each, the large ends all tending the same way, and the bundles then buried to prevent their drying out. They should be buried at least ten or twelve inches deep, to prevent drying. Freezing will not hurt them.

Cuttings should be set in the spring, and the ground should be prepared same as for seed if can be. They should be set in the permanent places, the same distance apart as when planting the regular forest, four feet apart. They may be set straight or slanting, as is convenient, and the earth firmly packed around them. Not more than two inches of the cutting should be left out of the ground after setting.

They should be cultivated well to keep weeds and grass down and the soil loose for growing. Where the soil can not be well plowed and pulverized a good method to set cuttings is to use a "dibble" in making openings in the ground. This instrument is handy, cheap and the best to use in such cases.

SEEDLING TRANSPLANTING.

The preparation of the soil for planting seedlings is the same in all instances as has been given for seed planting. The making of excavations to receive the trees is the thing most difficult, to not impede rapid progress. If the trees are large and have spreading roots, the places must be made large enough to receive the roots without cramping them. It is better, therefore, to transplant the seedlings at an early age, in order to lessen the work as well as to insure better results of growing. Most seedlings at the ages of one or two years do not possess much root system, simply a straight stem with small hair fibers. If the ground is well prepared the planter can make the holes with a sharpened handspike by jabbing it into the loose soil and prying in all directions. If it can not be performed in this manner a circular spade, dibble or other implement adaptable to make the small holes necessary can be used. If the former plan is followed the planter can quickly make the holes, insert the slender root and firmly press the dirt around it. In all instances the dirt should be pressed thoroughly around the roots so that no air remains around them. To this cause may be attributed the death of many trees planted. In some instances a spade was inserted into the soil and the earth pried apart, the tree root inserted, the spade removed and the earth stamped firmly upon the roots. For planting the small seedlings various methods may be employed to make the excavations successfully.

If larger trees are planted, more work and effort will be required to make the holes and to plant the tree properly.

The digging of the seedlings should be performed in a way not to injure them. In a small nursery, and when the trees are young, a sharp spade can be used by cutting along both sides of the rows and then lifting the trees out carefully. At all times mangling the trees should be avoided. It is not essential to prune unless the trees should become broken, when they should be pruned smoothly.

The trees may be dug in the fall and heeled in over winter for early planting in the spring. Young trees in this climate

should not be planted in the fall. The winters are too severe on them in their newly planted condition. The same thing is also true, in my judgment, for larger trees.

The trees can be heeled in in the cellar by keeping moistened dirt over the roots. The usual method of heeling trees is to dig a trench deep enough to bury the roots and the greater part of the bodies of the trees. Extend the trench east and west, the south bank sloping at an angle of about 30 degrees. Place the trees in the trench in single layers with the tops to the south and cover each layer with fresh earth. It is advisable to leave only the branches exposed. They may be left in the trench till they are taken out for planting. Select the site for the trench where the drainage is good.

When removed for planting, the roots should be plunged into a vessel containing a mixture of clay and water formed into a slush. The same thing should be done to the seedlings when taken from the nursery unless they are immediately planted or heeled in. The roots of any tree which it is intended to transplant should never be allowed to become dry.

The distances at which trees should be planted are 4, 5 and 6 feet apart for regular forest plantings, and should be in rows both ways to admit of cross-cultivation. They should be plowed or cultivated in some manner to keep down the weeds till they are large enough to survive by themselves.

The close planting enables them to soon shade the ground and thus conserve the moisture to them. Besides, it aids in natural trimming and long, straight trunk formation. Successive thinnings will be necessary when they begin to crowd and smother out.

The principle of tree growth is that if a tree is grown in the open it branches and forms a shade tree. The growth goes to limbs and branches instead of body formation. If it is crowded, it goes up in search of light, does not branch, and consequently a good trunk is formed to make the tree valuable.

SHADE AND ORNAMENTAL TREE PLANTING.

SELECTION.

The selection of the trees for ornamental planting should be attended to with care, and only such ones chosen and planted as are hardy to the conditions at hand. Trees on public grounds are exposed to injury more than on private grounds. Any trees which can not endure moderate abuse should not be chosen. The soil of the grounds intended for planting should be studied, because differences in soil make necessary differences of tree selection and all the attending features of propagation. Because a tree is known to grow in the locality does not imply that it will grow on any spot in the community. Sandy soils and clay soils are found in alternate relation in almost any part of the State, in both strata and territorial connections, and a tree which thrives in one soil may have a struggle to exist in another. When a study of the soils has been made to determine the differences in kind and porousness and then adaptable trees selected, rightly planted and properly cared for, after-success is almost assured.

There are also other questions which should be considered before the selection of trees is made, and they are the permanent devotion of the ground to the purpose for which tree planting is done, the immediate needs and the space allotted to a tree. If the grounds under consideration are to be devoted permanently, so far as can be foretold, to the use for which it is set apart and the present needs of tree decoration are not urgent, then the long-lived trees should be chosen and such as will correspond with the other conditions of soil and moisture. If the area is not likely to be permanently devoted to the present uses, and the decoration is to fill a limited time and necessary want, then the short-lived, fast growing trees should be selected. In cases where the conditions are permanent and the needs immediate a compromise can be made by planting the different lived trees in alternate harmony. They may be planted closely and at a proper development in growth the short-lived trees can be cut out and the permanent trees left at proper distances.

In places where the space will not permit large spreading-top trees, the selection should be of trees the tops of which are more

dense and compact. The following lists will give information concerning selections. The long-lived trees best suited for decorative plantings on permanent open grounds are the American elm, American ash, sugar maple, Norway maple, Tulip poplar, linden or basswood, American chestnut, sweet gum, sycamore, scarlet oak, red oak, white oak, yellow locust and some of the evergreens. Those best suited for limited time are red maple, ginkgo, pin oak, horse chestnut; hackberry, catalpa, Lombardy poplar, some of the evergreens and a few foreign varieties. Where the space is limited but permanent, the trees best suited and which adapt themselves to the conditions are the sugar maple, Norway maple, linden, chestnut, sweet gum, American ash, scarlet and red oak and tulip poplar. The trees which should not be planted any place for decoration are the Carolina poplar, silver maple and other similar kinds.

PLANTING.

The time and method of planting should be given the closest attention. The time is subject to difference of opinion, but such is mostly due to the object in mind. If an agent or individual cares only to dispose of his trees he may argue that any time is good for planting, but a scrupulously honest individual will not disregard the proper time to plant. In Indiana fall planting may sometimes be done to advantage, but it can not be held as a rule to practice. In all ordinary conditions early spring planting is more successful, especially for deciduous trees. The best time is immediately after the freezing is over and the soil is dry enough. The reasons given against fall planting are that the trees do not get sufficiently established root system to sustain them against the hard freezings and thawings of the winter. If it is possible the planting should be done on a cloudy, cool day, and unless the atmosphere is very moist, the trees should be kept moist by having their roots submerged in water or a thin mixture of earth and water, and only removed as they are planted. A very few minutes' exposure to the air will injure the small roots which are the feeders of the tree.

The holes for the trees should be dug a few days before the time of planting. They must be large enough so that the roots can be placed in their natural positions without the least cramp-

ing. It is well to have a foot or more additional space on all sides of such ample depth that plenty of loose soil can be placed under the roots. In digging the holes place the top soil by itself, and if the lower soil is poor and lumpy it should be substituted by richer, finely pulverized earth for the planting. Use no manure unless it is thoroughly mixed with earth, and such should not be placed around the roots, as manure will burn and rot them. Good, clear, rich, heavy, finely pulverized soil is at all times better for tree planting. By digging the holes a few days beforehand the soil requisites can be arranged and the proper moisture conditions secured. If the earth is too wet it will afford time for proper drying out, and if too dry it will afford time to fill the holes with water and saturate till the result is satisfactory for good planting. A good drainage is essential, as but few trees will live in a place where water settles around the roots and is retained by a heavy clay.

The tree should be set at a depth of an inch deeper than it originally grew, and should be set firmly and fastened by strings tied to stakes to prevent the winds from swaying and loosening it in the ground. Be careful in doing this not to injure the bark. After planting, the ground should be mulched around with rotten substance, either of straw, tanbark or sawdust. This device will not only retain the moisture but will keep down the weeds and fertilize the soil. With this treatment watering will not be necessary except in excessive drought, in which case several gallons of water should be poured around the roots of the tree every few days until the danger is passed.

Many of the reasons for the failure of the tree to live and grow after it has been planted can be ascribed to the injuries sustained in digging it up. The roots are torn, strained and mutilated, or such scanty root system is taken up that the tree has no means of keeping up life. In digging up the tree the roots should be preserved as entire as possible and entirely practical. If the tree is of a dimension of an inch or two in diameter and of four or five years' growth, the root system should be preserved for at least three feet around the stem. Extreme caution should be exercised in retaining the small feeders. If a larger tree is taken up, a ball of earth of the dimensions above should be kept compactly intact with it and planted. Having carefully dug the trees, the roots

should be examined and all bruised and broken roots cut away smoothly and completely. By so doing decay will not occur and fibrous roots will form quickly around all such places. Tap roots may be cut down to easy requirements for planting in the cavities. The tops of the trees should always be pruned back to harmonize with the diminished root system caused by digging. A good suggestion is the cutting of the branches back from one-third to one-half, but at no instance should they be cut to bare poles. In cutting the top back the branches should always be cut near a bud as the pruned member will always die back to the nearest bud. This will avoid the dead stubs so frequently seen on pruned trees a year or so after.

When trees are selected from the forest, they should be secured from regions open to the sun rather than from a densely shaded area, as trees from the latter places are tender and weak and will not survive the sun and open exposure. All newly planted trees should be protected on the extreme side to the sun exposure by boards or tree boxes. Figs. 1 and 2 on following page give good forms of protection and are very simple in construction.

PRUNING.

As trees become and grow older they may occasionally require pruning to remove dead limbs to improve their form and in some cases to restore them to vigor, but it seems the height of folly to prune the trees as is the prevalent custom at this time. The work of trimming shade trees in cases where it should be done should be entrusted to experienced persons only. Frequently there are parties in our cities soliciting employment as tree pruners who, by their glibness of tongue, are enabled to convince owners of their ability and obtain permission to do work for which they are the most incompetent. As a result beautiful specimens are disfigured and irremediably injured. It seems to me there is no worse injustice being perpetrated on the public than the unmerciful and unskilled trimming frequently given our shade trees in the cities.

It is true that some shade trees can be improved in appearance by an occasional trimming or cutting back in order to correct irregularities or to adapt it to a situation, and by a skilled professional pruner such work can be done without injury to the tree.

When a tree becomes stag-headed, dead at the top, or containing dead limbs, it is necessary to correct it by cutting out such defects in a proper manner. Old trees that have become bare and unsightly may often be restored to vigor and beautiful foliage by severe pruning, but any extensive trimming of this kind is only

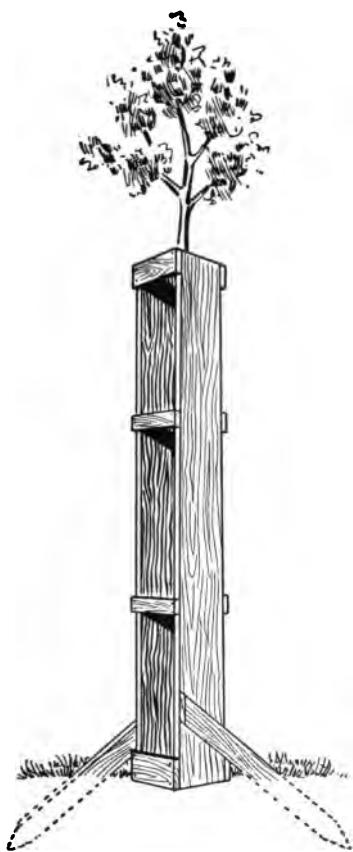


Fig. 1.

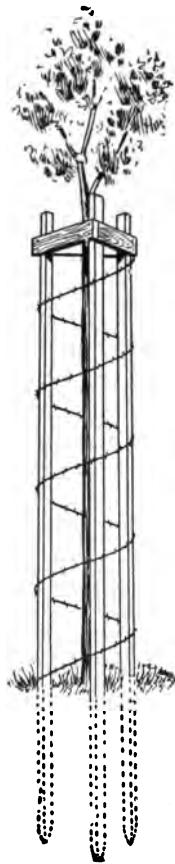


Fig. 2.

justifiable in such instances. Some trees, along walks and driveways for instance, can be more useful under certain conditions by increasing their height, which can be accomplished by cutting off their lower limbs, but this operation requires intelligent workmanship and should not be resorted to unless necessity requires.

The best time for pruning trees is in the fall of the year soon after the leaves have dropped, though they may be pruned in the spring with safety, but it must be done early and before there is any swelling of the buds. Soft maple and other rapid growth trees may stand moderate trimming during sap season. Whenever a branch is removed, whether a dead or a live one, it must be cut off close to and even with the trunk, no matter how large the wound. The new wood and bark will then in time cover the denuded space. If a branch is not cut off close to the trunk, the projecting stub soon decays, its bark falls off and the stub remains, and the dead, decaying wood in time forms a rotten mass extending into the heart of the tree and offering lodgment for beetles and borers. Trees trimmed in the fall, as I have indicated, heal over better and do not decay.

In removing a large branch, enough of the outer portion should be cut below to prevent its weight from splitting the wood downward when the final cutting is made. All wounds made in pruning should be covered with coal tar or white lead to exclude air from the raw surface. Coal or gas tar, by penetrating parts of the wood, acts as a preservative and prevents the inroads of fungi and insects. If the pruning is done at a time when the sap exudes readily, the painting should not be done for a few days until the cut is dry, when it will adhere more readily to the wood.

It is a misery to see how many of our shade trees are defaced and mangled by unskilled trimmers. Many of our shade trees in the city, by unskilled trimming, are made full of knots, stubs, boils, cankers and deformed branches, making them examples of utter destruction as far as the purpose for which they were destined. As much to be reprehended are persons who do unskilled, unseasonable trimming as those who are polluters of society.

When an observer stops to compare the beautiful formed trees throughout the country where systematic trimming, as carried on in our cities is unknown, it ought to be evidence that constant trimming is wrong and should be abolished. I do not believe there can be found any justification for it, and I urge that persons interested in this matter use their best judgment to prevent it. The thing, it seems to me, most needed to make our trees beautiful in our cities is not trimming, but that they be planted at

greater distances and allowed to form naturally, that they be given more opportunity to live by being relieved from many of the injuries sustained in general city improvements, both in extent and plan. I believe the time is propitious for property owners, who delight in having their property improved with beautiful shade trees, to study the subject very carefully and use their efforts to accordingly readjust the evils prevailing.

EFFECTS OF FORESTS ON CLIMATE.

The effects of forest on climate as pertain to the temperature of the air and the soil, and to the amount of moisture and the movement of water by nature, has been observed and recorded by systematic efforts for several centuries. Volumes of records of such observations have been compiled from instances in which forest vegetation has affected the rainfall, the temperature, the moisture, the healthfulness and the stability of the soil. The quantity and the manner of the evidence is such that there is no longer reason for doubt, except as to the absolute extent of the same. The early data recorded were not very accurate, because the other agencies acting at the same time made it difficult, under the rude means used in making the tests, to determine the forest influences alone. But since 1867 very accurate, complete tests have been made and the results recorded by the authorities of France, Germany, Switzerland and India, and the same will be here given for consideration, and because no data of consequence have been completed and recorded by the American authorities. Forestry in the countries named is an institution of several centuries standing, and has developed to an almost complete, thorough, scientific study in every detail and relation. In America it is yet a comparatively new thing, and, consequently, a matter for future advancement and experiment.

The history of this scientific research by later authorities in the countries named is brief. In 1867 Dr. E. Ebermayer established a series of double stations in Bavaria, Germany. He selected a site possessing a fully stocked forest with an adjoining open country and possessing identical conditions of elevation, soil and other conditions which by any perceivable manner might influence the results. Stations were placed at different points in the forest and other parallel ones established at some distance outside in the open country. The result has been a rich lot of reliable observations and much has been learned and established. Other countries of Europe followed the example of Bavaria, and about twenty years ago similar stations were established in India. Since 1888 much improvement has been made in the manner and correct results of

these stations, and the tabulations herein given are those of the latest observations.

EFFECT OF FORESTS ON TEMPERATURE OF THE AIR.

The results of the observations made by the stations mentioned above show that forests very materially affect the mean temperature of the air of the four seasons, and of the year. The seasons observed were Spring, Summer, Autumn and Winter, and the division of calendar months was the same as now used by us. The distance above ground at which the measurements were taken was five (5) feet. A reduction of temperature in the forest is shown by the sign (—) and an increase in the temperature is shown by the sign (+). The temperature of the open country is taken as the standard from which comparisons are made, and the temperature in the forest is shown to be so much below or so much above it, governed by the season. The same signs and distance will hold for the following tables:

<i>Season.</i>	<i>In the Open Country.</i>	<i>In the Forest.</i>
Spring	—1.24°F.	—.59°F.
Summer	—2.54°F.	—1.48°F.
Autumn	—1.13°F.	—.41°F.
Winter	—.61°F.	+.05°F.
Mean of Year	—1.04°F.	—.41°F.

The above data shows that the difference of the temperature of the air is greatest in summer, smallest in winter and that spring and autumn stand about half way between.

The following table shows the result of the observations of the Bavarian stations calculated for a day of twenty-four hours by seasons. It shows only the differences of the temperature in the forest compared with that of the open country as so much above or below it, and indicated by the sign (+) and (—).

<i>Season.</i>	<i>MINIMUM.</i>		<i>MAXIMUM.</i>	
	<i>At Night.</i>	<i>8 a. m.</i>	<i>Early p. m.</i>	<i>5 p. m.</i>
Spring	+.81°F.	—1.82°F.	—3.87°F.	—2.09°F.
Summer	+3.15°F.	—3.42°F.	—7.42°F.	—3.44°F.
Autumn	+2.59°F.	—.99°F.	—4.00°F.	—1.06°F.
Winter	+.95°F.	+.27°F.	—1.96°F.	—.99°F.
Mean of Year	+1.87°F.	—1.49°F.	—3.91°F.	—1.89°F.

The result of these observations show that the temperature in forests is higher during the night and lower during the day than it is on the open ground, and that the difference is most pronounced in summer and autumn. Forests, therefore, tend to moderate the extremes of heat and cold. The observations of the Prussian stations for the months of July and January for a period of ten years show the following mean differences. Difference of the absolute maxima of temperature in July for ten years— 5.87°F . Difference of absolute minima of temperature in January for ten years $+2.70^{\circ}\text{F}$.

These results indicate that forests influence to lower the temperature in July and to raise it in January, which is a matter of very great concern in a climate like that of northern Germany.

The observations of the stations at different points also led to the discovery that the kind of forests had a great deal to do with moderating the extremes. In a forest of deciduous trees the extremes were moderated in July almost double what they were in pine and spruce forests. Just the reverse was ascertained of these forests in January, a fact due to the character of the foliages.

EFFECT OF FORESTS ON THE TEMPERATURE OF THE SOIL.

The effect of forests on the temperature of the soil is about as marked as that of the temperature of the air, and as the temperature of the air varies in distance from the earth so does the temperature of the soil vary from the surface downward. The observations made by stations established in the countries named for the purpose of ascertaining these facts are here given.

These figures are the differences as in the preceding table:

<i>Season.</i>	<i>Surface.</i>	<i>1 ft. below.</i>	<i>2 ft. below.</i>	<i>3 ft. below.</i>	<i>4 ft. below.</i>
Spring.....	-4.45°F .	-3.33°F .	-3.17°F .	-2.84°F .	-2.43°F .
Summer.....	-6.89°F .	-6.71°F .	-6.80°F .	-6.84°F .	-6.64°F .
Autumn.....	-2.29°F .	-2.41°F .	-3.02°F .	-3.29°F .	-3.64°F .
Winter.....	$-.20^{\circ}\text{F}$.	$+.41^{\circ}\text{F}$.	$-.04^{\circ}\text{F}$.	$-.00^{\circ}\text{F}$.	$-.29^{\circ}\text{F}$.
Mean of Year.....	-4.14°F .	-3.02°F .	-3.24°F .	-3.20°F .	-3.17°F .

There are several conclusions which may be drawn from this data. The first is that the mean annual temperature of the soil from one foot and downward to four is almost the same. It is also evident that the mean annual temperature of forest soil is decidedly

lower than the soil in the open country. It is also seen that in spring the temperature is lower from the surface downward, while in the autumn the reverse is true. This is due to the fact that changes of temperature at the surface are transmitted slowly to the strata below it.

The same marked differences that were found relative to the effect of the different kinds of forest, deciduous and evergreen trees, upon the temperature of the air is also seen in the soil temperature. Evergreen trees reduce the temperature much more than do the deciduous kinds.

EFFECT OF FORESTS ON THE MOISTURE OF THE AIR.

Air can hold only a certain amount of vapor at a given temperature. The maximum quantity of vapor the air can hold at any certain time is limited by its temperature. As the air becomes heated it expands and is capable of holding more moisture, but as it becomes cooled it condenses and it can not hold so much. The quantity of moisture which the air possesses at any certain time may or may not be the amount of its capacity. Whatever the amount of moisture held by the air at any time may be it is called the absolute quantity. The proportion of the moisture which the air contains to the maximum quantity which it is capable of holding at any certain temperature is called the relative humidity of the air. When the air at any temperature contains all the moisture which it can hold it is said to be saturated and the point at which it begins to give off the moisture in any form is called the saturation point. If these facts are held well in mind the ways in which forests affect the air will be more clearly seen, since the humidity of the air depends upon the distribution of heat which is largely modified by bodies of water and surfaces covered with vegetation. The following laws govern climatic changes:

1. The quantity of heat received by the entire earth is the same for all equal parts of the orbit.
2. A heavy atmosphere displaces a light one, or a cold atmosphere displaces a warm one.
3. Changes in material produce corresponding changes in climate.

4. Barren land areas take on heat more readily than do areas of water or those covered with vegetation and likewise give it off more quickly.

5. Barren regions have greater extremes of temperature than do regions of abundant vegetation.

6. Rainfall is greater in regions of heavy vegetation.

7. Cold air contracts and is forced to throw off its moisture while heated air expands and is capable of receiving more moisture.

A study of these laws of atmospheric changes and the causes thereof will reveal evidence favorable to forests which can not be rebutted. They can be made the means of correcting atmospheric evils to a great extent.

The following tables show the effect of forests. The measurements were taken at a distance of five (5) feet above the ground:

MEAN ABSOLUTE VAPOR TENSION IN INCHES.

<i>Season.</i>	<i>In Open Ground.</i>	<i>In Forest.</i>	<i>Excess in Forest.</i>
Spring.....	.2788	.2824	+.0036
Summer.....	.4626	.4618	-.0008
Autumn.....	.2806	.2886	+.0080
Winter.....	.1820	.1918	+.0098
Mean of Year.....	.3010	.3064	+.0054

The figures show that forests do not effect the absolute humidity of the air to any great extent.

MEAN RELATIVE HUMIDITY IN PER CENT. OF SATURATION.

<i>Season.</i>	<i>In Open Ground.</i>	<i>In Forest.</i>	<i>Excess in Forest.</i>
Spring.....	74.96	80.66	+5.70
Summer.....	71.92	81.20	+9.28
Autumn.....	82.72	87.94	+5.22
Winter.....	84.19	89.43	+5.24
Mean of Year.....	78.45	84.91	+6.36

The figures here given show the effect is very appreciable. Other observations made show that altitude has a very decided influence. At an altitude of 1,066 feet above the sea level the excess amounted to only 3.14 per cent., while at 2,956 feet elevation the excess was 8.79 per cent.

Differences of excess were also ascertained for the kind of forests. The greater excess was found in forests of deciduous trees in the summer and less in evergreen woods. The reverse of this was found to be true for the winter season.

It is known by all who have given the matter any attention that the formation of dew is greater near forests than in open grounds, and that dry air currents entering a forest soon become saturated. Other evidences of the influence of forests on the moisture of the air might be cited, but there is no cause for the opinion frequently held that forests are producers of rainfall. It is an erroneous judgment to say that rainfall can be secured by planting and fostering a sufficient forest area. But it is not a false judgment to assert that forests by their influences aid in the supply of moisture to the air and that they conserve the rainfall to the soil by preventing hasty evaporation, retaining it in the humus and litter and by directing it into the earth by means of the roots.

EFFECTS OF FORESTS ON EVAPORATION AND WATER SUPPLY TO THE SOIL.

Because of the decreased temperature, the increased humidity and the undisturbed state of the atmosphere, the extent of evaporation must be much less in forests than in the open country. The effect of these things is, that of the quantity of the water which falls in forests a much larger part is retained to the soil than is held for the soil in the open. Omitting the fact that about twenty-five per cent. of the rainfall in forests is intercepted by the foliage, it still remains that about twice as much water penetrates the soil in forests as occurs in the open fields. As indicated in the foregoing topic, the water in forests is held by agencies which conserve it, to be taken up by the soil, and it is afterwards steadily given off to feed streams, springs and to saturate the dry currents of air which may enter the forests. They act as storage reservoirs. The figures recorded by the stations making observations of such phenomena are as follows:

1. Evaporation and escape of water from the soil in the open countries, because of the lack of conserving agencies, is placed at one hundred (100) parts.

2. Evaporation and escape of water from the soil in forests of no leaf mold, compared to the above, is forty-seven (47) parts.

3. Evaporation and escape of water from the soil in forests of full leaf cover and humus, compared with the first, is twenty-two (22) parts.

It may be argued that trees take the water from the soil by means of the roots and pass it off by the process of transpiration and thus the soil is drier in the root regions. All this argument is true, but the soil near the surface in such instances remains very much moister than at the root depths, but with all such concessions it still remains that the evidence favorable to forests is overwhelmingly larger, and the same can not be refuted.

The tables here given show the results of the observation made, and is for the quantity of water evaporated in inches from a free surface of water:

<i>Stations.</i>	<i>In the Open.</i>	<i>In Forest.</i>	<i>Decrease in Forest.</i>
Bavarian	23.53	8.61	-14.92
Prussian	18.16	5.98	-7.18
Mean	18.34	7.29	-11.05

These data show that evaporation in the forest was only about two-fifths of that in the open country.

The facts here given may not be accurate, but they surely furnish evidence for reflection and study. If the evidences submitted throughout this discussion are true to any degree, and there is no reason to doubt their absolute correctness, it is timely that forests be preserved and perpetuated for the welfare of all. The hygienic state of the country is largely governed by the climatic conditions.

**REPORT UPON A BOTANICAL SURVEY
OF THE
INDIANA STATE FOREST
RESERVATION**

By CHAS. PIPER SMITH

**WITH ILLUSTRATIONS FROM NATURE
BY THE AUTHOR**

PLATE 1.



YELLOW PINE
(Pinus echinata).

A REPORT UPON THE PLANT LIFE OF THE RESERVATION.

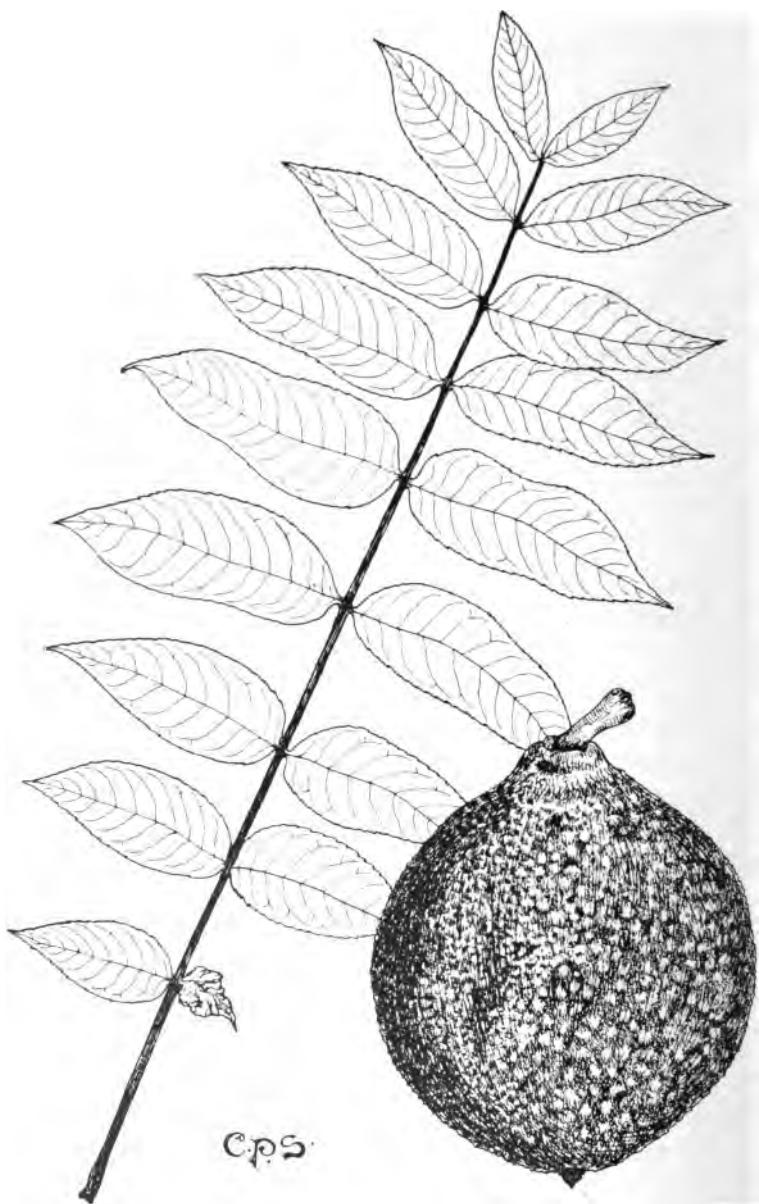
INTRODUCTION.

The materials for this report were obtained during a sojourn upon the Reservation between the dates of July the twentieth and August the twentieth, nineteen hundred three. The work was done at that time not from choice, but rather from necessity, and the time was, perhaps, not the best suited for the purposes in view.

The major object of the survey was to classify the trees and study their relations, and to prepare a map showing facts of importance concerning the forestry conditions. Secondly, it was desired to compile a list of the other plant life of the Reservation, making the same as complete as possible, though, considering the time limit, it was expected that perhaps one-half of the species would remain unrecorded. In this connection I wish to here acknowledge the courtesy shown me by Mr. Edwin L. Holton, who went over his notes with me and permitted me to incorporate in my list many of his records, elsewhere credited to him. Mr. Holton, now a student at Indiana University, has spent much time in systematic botanical work about Henryville, and I much appreciate the additions to the list obtained through his kindness.

While, undoubtedly, the plant list is yet far from complete, especially as regards grasses and sedges, goldenrods, asters, etc., I am quite sure that no additions will be made to the list of indigenous trees, unless perhaps other willows or haws be recognized by some future observer. Possibly, also, though contrary to my expectation, one or two additional oaks may be found at some out-of-the-way point on less frequented knob sides. For instance, a clump of easily recognized chestnut oaks, *QUERCUS ACUMINATA* (Michx.) Sarg., was noted on the bluff just east of Henryville, under conditions many times duplicated upon the Reservation. Again, several quite typical specimens of the scrub chestnut oak,

PLATE 2.



BLACK WALNUT

(*Juglans nigra*).

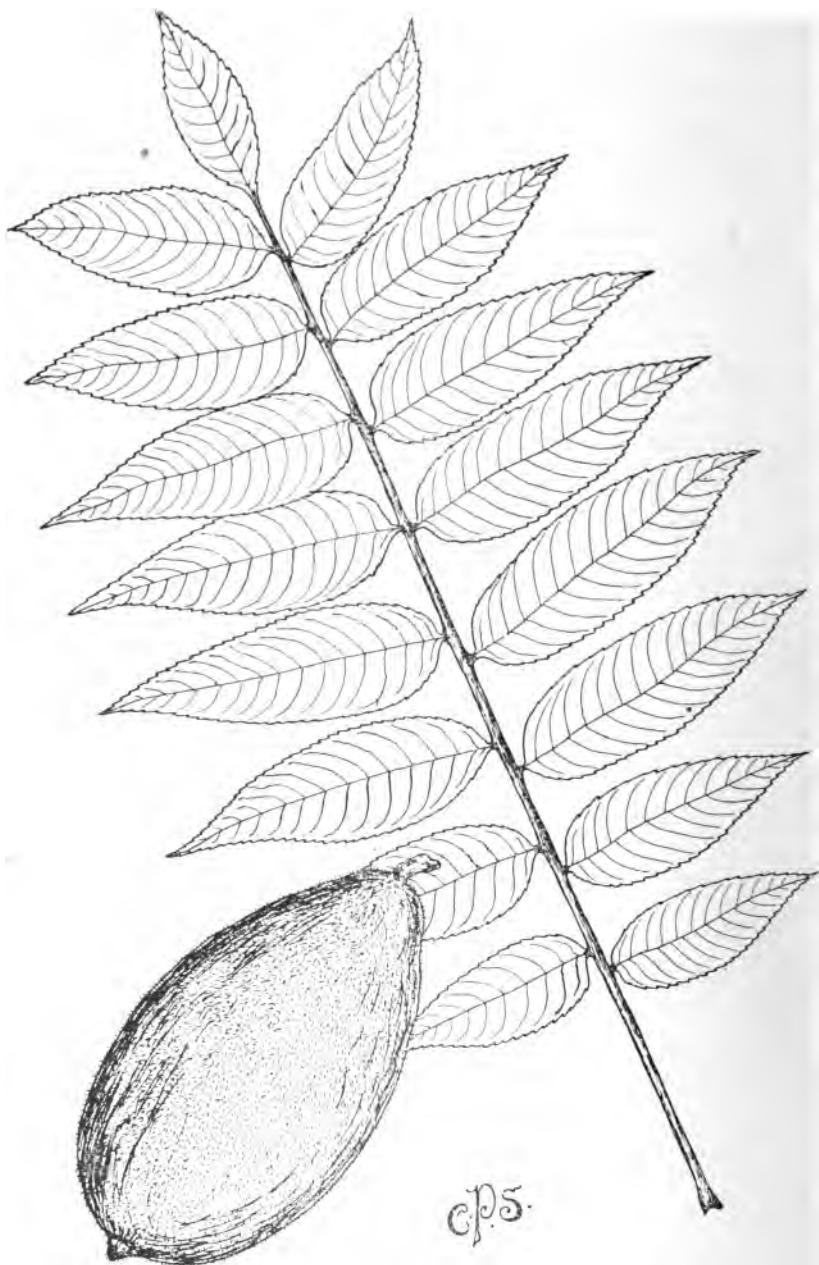
QUERCUS PRINOIDES Willdenow, was observed by me under practically similar conditions (on dry knob sides) just south of Louisville, Kentucky. Rather expecting the presence of these two forms upon the Reservation, I was constantly on the lookout for them, so that my failure to note them there gives me strong ground for believing them not constituents of the flora of the Reservation.

The soil of the Reservation is a fine light yellow clay, the result of the decomposition of a soft shale, certain strata of which are somewhat, or extensively, reddened and hardened by the presence of iron compounds. This clay soil is naturally overtopped by a rich vegetable deposit in certain moist levels along the lowland streams; also on some of the ravine sides a rich mould is held in place by the roots of the abundant shrubbery. However, on many of the knob sides, where in more recent years the forest fires have licked up the soil-holding vegetation, the rains and snows of winter have easily swept from the steep slopes the loose loam and fine clay, leaving exposed the crumbling edges of the variant strata, and forming the "barren knob sides" upon which vegetation is now desparately struggling to reinstate itself.

The forestry knobs seem to be devoid of springs, and no running water was found upon the Reservation during my stay. This is partly, if not entirely, due to topographical conditions, discussed by others elsewhere in this volume. The streams, apparently, receive their supply only from rains or melting of snow. Their beds are mainly, if not entirely, of the soft, porous strata already mentioned, and much moisture is thus retained and is available to the plant life bordering their courses. Thus an extremely dry soil condition exists generally over most of the area of the Reservation. No sand was found anywhere within Reservation limits, all the so-called "gravel" being merely "chips" of the iron-bearing shale.

While many plants ordinarily indicative of rich soil are found upon the Reservation, these are necessarily of quite limited distribution, being mostly confined to the borders of the streams and to shaded ravine sides or beds; while by far the greater portion of the land is clothed by forms strongly indicative of dry, more or less sterile regions. To the botanist many of these plants have great interest because of their comparative rareness in the State.

PLATE 3.



BUTTERNUT
(Juglans cinerea).

In relation to forestry, however, the "story" told by the plants is that the land has decided limitations in regard to raising certain valuable timbers. Trees requiring rich, moist soil will evidently not meet with rapid development there, though they may, perhaps, be produced in limited areas. The scarlet oak seems to be best adapted to conditions upon the Reservation, for though the white oak exceeds it in point of numbers, the "scarlet" seems to be making better development under all conditions. A more particular discussion of this subject will be found in the consideration of the species separately. Much knowledge will have to be gained, however, from direct experimentation. The modern attitude, expressed in the saying, "Nothing is impossible to him who tries," may be worthy of consideration in this work. A study of the accompanying map will, it is hoped, give additional data of interest and use.

The nomenclature and sequence of species followed is that of Britton and Brown's Illustrated Flora. Though, for obvious reasons, the timber trees have been separated into a list by themselves, the sequence has not been varied.

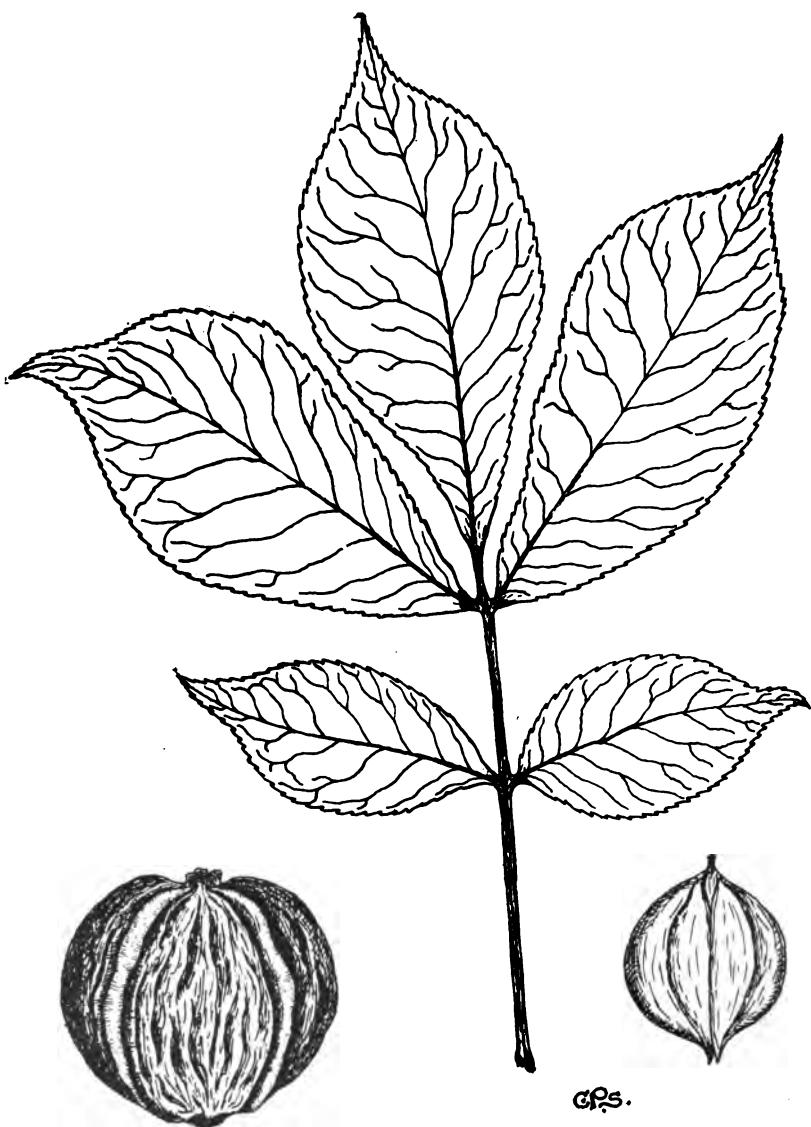
In the pursuit of these studies the following publications were used, and my acknowledgments are due to the respective authors for the great service rendered:

Prof. Stanley Coulter's "Catalogue of the Flowering Plants and of the Ferns and Their Allies Indigenous to Indiana"—in State Geologist's Report for 1899.

Britton and Brown's "Illustrated Flora of the Northern United States, Canada and the British Possessions." 1896-'98.

Miss Keeler's "Our Native Trees and How to Identify Them." 1900.

PLATE 4.



G.P.S.

SHELLBARK HICKORY
(*Hicoria ovata*).

Leaf four-ninths natural size; fruit and nut full-size.

THE TREE LIFE OF THE RESERVATION.

A Summary of the Indigenous Species, With Notes Concerning Their Relative Abundance and Distribution and Suggestions for Use in Determining Certain Forms.

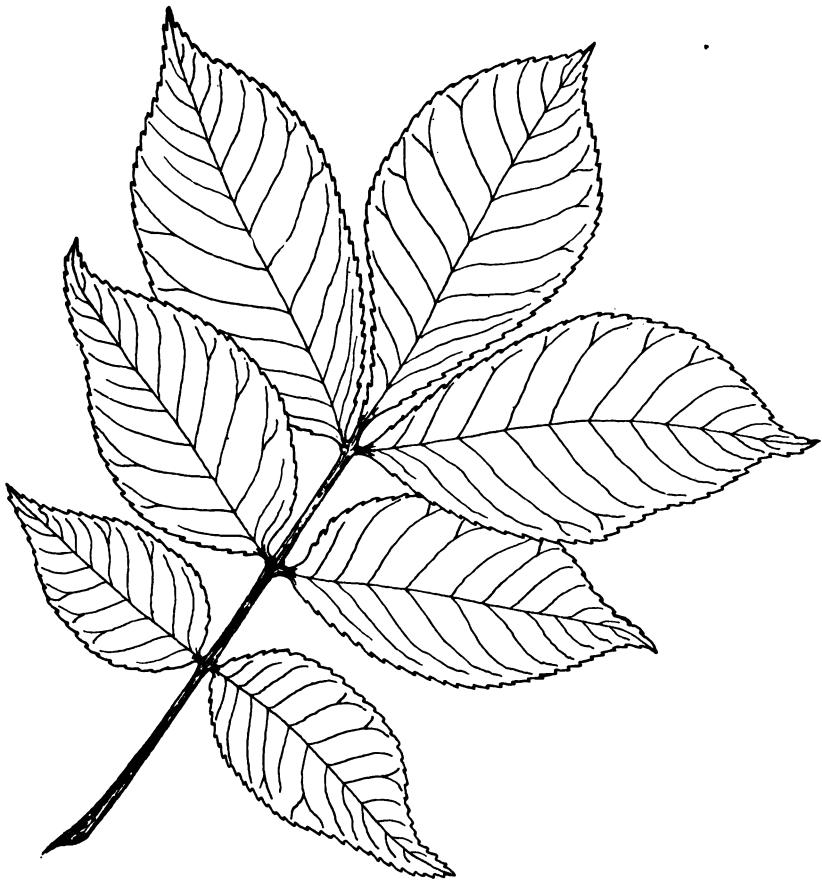
PINUS ECHINATA Mill. Yellow Pine. (Plate 1.) The only conifer upon the Reservation. Found generally in patches, upon the crests of the knobs, frequently extending down the slopes, and also, as isolated individuals or small clumps, here and there over the lowlands. In one section, approximately located by the figure "86" upon the map, the pine averages about 133 trees to the acre, where the total number of trees averages about 520 to the acre. In the vicinity of the number "88," my calculations show about 40 pines to the acre, where an average of 670 trees to the acre includes all species. On the north and west slopes of the "Geodetic Knob" (94, on my map), two-thirds of 150 trees to the acre are pines. In the extreme northwest corner (666), about 40, out of some 500 trees to the acre, are pines. In general, trees included in my estimations are over two inches in diameter. The largest pines are about eighteen to twenty-four inches in diameter.

JUGLANS NIGRA L. Black Walnut. (Plate 2.) One of the rarest trees upon the Reservation. An occasional specimen found at various places, where its abundance did not warrant its being considered in any of the estimations made. Noted in the vicinities designated by the figures 444, 98, 66, 26, 24, and 22.

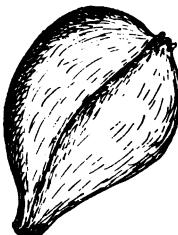
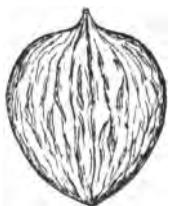
JUGLANS CINEREA L. Butternut. White Walnut. (Plate 3.) Less common than the preceding. A few fine large specimens occur in the ravine-openings marked "888" and "444." The leaves usually have only one terminal leaflet and the bark is much smoother and lighter than in the black walnut.

HICORIA OVATA (Mill.) Brit. Shag-bark. Shell-bark Hickory. (Plate 4.) The second hickory, in point of numbers, upon the

PLATE 5.



C.P.S.



PIGNUT HICKORY
(*Hicoria glab.a*).

Leaf about one-half natural size.

Reservation. A large tree, in fruit, is easily recognized; but where five hickories occur, and a large percentage of the trees to be estimated are very young ones, too young to bear fruit and be normal in leaf and bark, I found it necessary to have my figures include all hickories at hand, regardless of species. This form is most abundant in the ravines and along streams. The fruit is about as high as wide; the hull is thick, completely separating into four portions. The nut is angled, the shell being thin. The leaves are usually of five leaflets, but sometimes seven. The bark is normally shaggy, separating into longitudinal strips. These points, I believe, will enable anyone to name most of the matured trees with which he comes in contact, remembering, meanwhile, the peculiarities of the following four species.

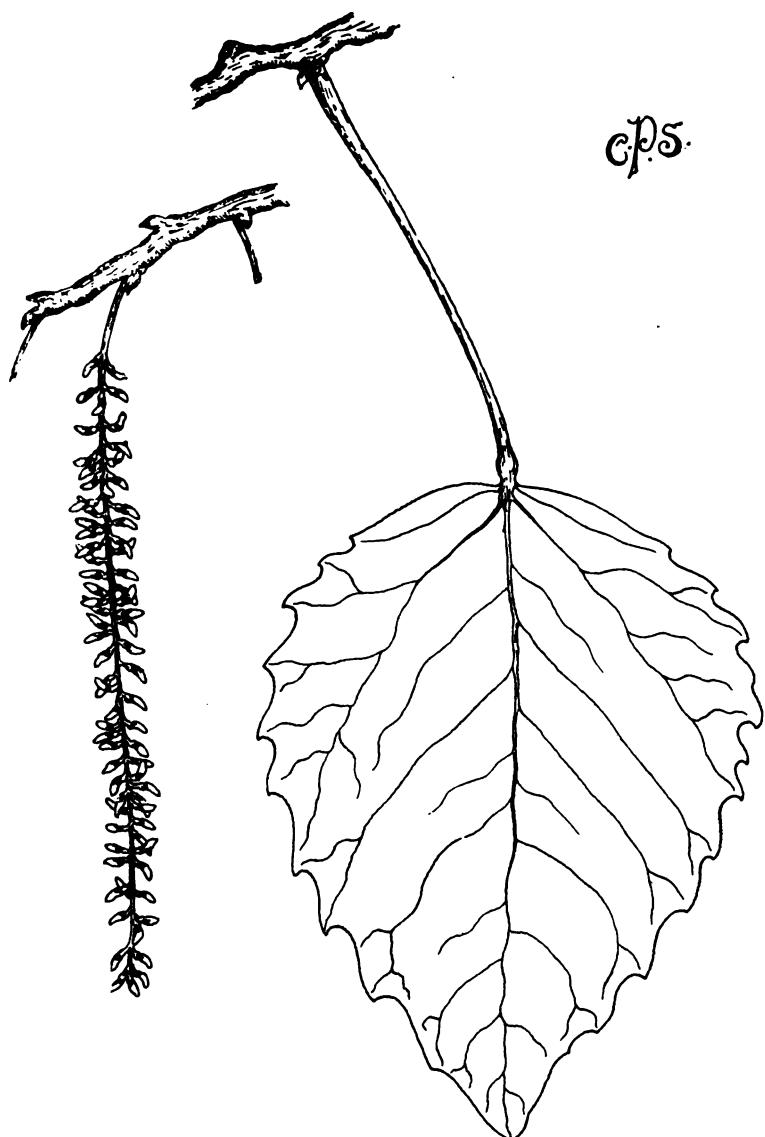
HICORIA LACINIOSA (Michx. f.) Sarg. King Nut. Big Shag-bark. Not as common as the preceding, but occasional in similar situations. Resembling the shell-bark proper, but to be distinguished by the following indicated differences: Fruit larger, longer than wide, nut also larger, longer than wide, and thick shelled. Leaves usually with seven to nine (7-9) leaflets. The bark is indistinguishable from that of the shell-bark.

HICORIA ALBA (L.) Brit. White-Heart Hickory. Mockernut. Only occasional in woods near the southern and eastern boundaries. Bark rough and close; leaves pubescent, fragrant when crushed; leaflets 7-11, narrow; fruit either sub-globose or much longer than wide, the hull thick and freely separating into quarters, the shell thick; thus the fruit, alone, not easily distinguishing this species from the king nut.

HICORIA MICROCARPA (Nutt.) Brit. Small-fruited Hickory. Rare; as far as noted, confined to the richest soil of the southern boundary. Bark rather intermediate between that of the pignut and the shell-bark. Fruit nearly globose, quite small; hull thin, not completely separating from the nut; shell not angled, thin; kernel sweet, edible.

HICORIA GLABRA (Mill.) Brit. Pig-nut Hickory. (Plate 5.) The most abundant hickory upon the reservation, forming, perhaps, more than 66 per cent. of the aggregate. Found everywhere, on the knob tops and sides, in the ravines, and through-

PLATE 6.



LARGE TOOTHED ASPEN
(*Populus grandidentata*).

out the lowlands. Mature trees to be recognized by the following characteristics: Bark close and rough; leaflets 3-9, commonly 5; fruit obovoid (see illustration), hull thin, not readily separating; nut smooth or somewhat angled, shell thicker; kernel bitter, rejected by most persons.

As already indicated above, the following calculations are concerned principally with the pignut and the shell-bark, the king nuts amounting to very little in the summation. Further, it should be remembered, these percentages are largely due to sapling growth.

Vicinity	82; 220 hickories	out of	875 trees to the acre.
"	84; 340	" " "	1,540 " " "
"	76; 360	" " "	906 " " "
"	72; 150	" " "	790 " " "
"	54; 80	" " "	460 " " "
"	92; 160	" " "	420 " " "
"	777; 180	" " "	420 " " "
"	666; 120	" " "	500 " " "
"	555; 120	" " "	540 " " "
"	222; 60	" " "	360 " " "
"	98; 160	" " "	680 " " "
"	96; 10	" " "	210 " " "

The above estimates of total numbers of trees to the acre do not include the often superabundant sassafras, dogwood, ironwood, service berry, etc., apt to be felled in the clearing of the less valuable growth.

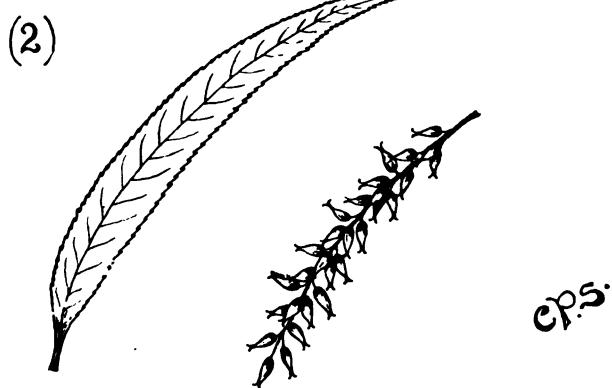
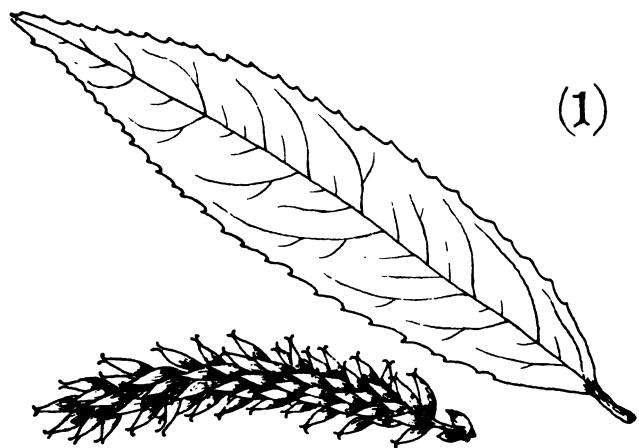
POPULUS GRANDIDENTATA Michx. Large-toothed aspen. (Plate 6.) Confined to the knobs and, further, mostly to the tops. Not at all common, being most in evidence in vicinities 86 and 333. Few trees are over two inches in diameter and none were noted over four inches. Easily recognized by the leaf and the smooth greenish- or yellowish-gray bark.

SALIX NIGRA FALCATA (Pursh.) Torr. Black Willow. (Plate 7; lower figure.) Frequent along the streams. Possibly other forms of this species should have been recognized.

SALIX ALBA VITELLINA (L.) Koch. Golden Osier. Occasional, along streams. Conspicuous because of its bright yellowish twigs.

SALIX DISCOLOR Muhl. Glauca or Pussy Willow. (Plate 7; upper figure.) Also along streams, but not very common.

PLATE 7.



(1) PUSSY WILLOW
(*Salix discolor*).

(2) BLACK WILLOW
(*Salix nigra*).

CARPINUS CAROLINIANA Walt. Hornbeam. Water Beech. Smooth-barked Ironwood. (Plate 8.) Frequent along some streams and in ravine mouths. Easily known by the angular stems, covered with a bark strongly suggesting the beech. Comparatively, one of the rarer trees.

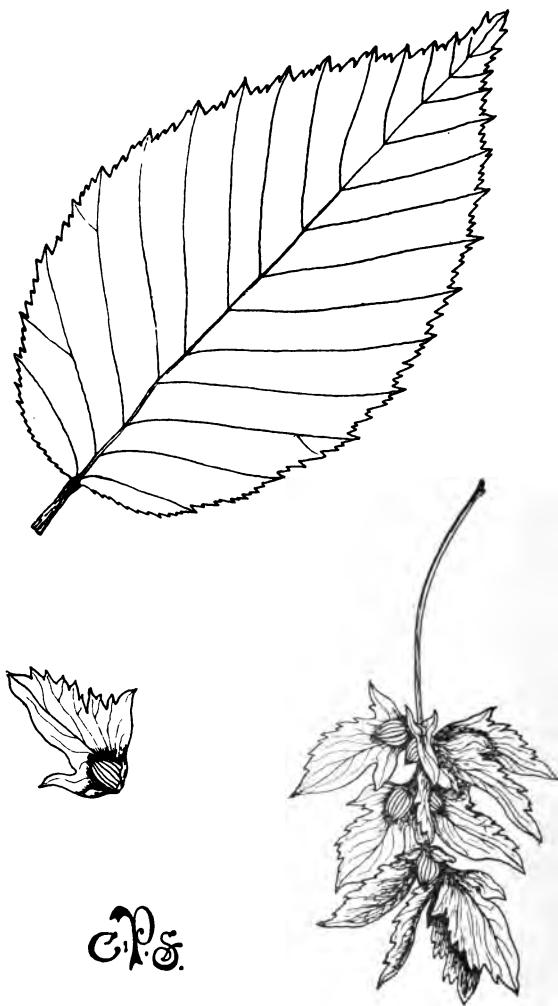
OSTRYVA VIRGINIANA (Mill.) Willd. Hop-hornbeam. Rough-barked Ironwood. (Plate 9.) Abundant upon the Reservation, especially in certain sections where it has advanced beyond the "sapling" stage and become a well-formed tree, four to six and seven inches in diameter. One estimate, in the vicinity 54, shows an average of 140 hornbeams, mostly of these large well-developed specimens, along with 160 large dogwoods, 40 hickories, 40 white oaks, and 20 black oaks to the acre; not many acres at these rates, however. The hornbeam is quite general in its distribution, being found, in varying abundance, almost everywhere.

BETULA NIGRA L. River or Red Birch. (Plate 10.) Common along some streams, especially those of the eastern boundary. Varying from one inch saplings to large trees almost, if not quite, two feet in diameter. Trees one foot through are common. Easily recognized by the reddish scaly bark of the trunk or limbs, in the older specimens the bark of the main stem being rough and furrowed, dark gray in color.

FAGUS AMERICANA Sweet. American Beech. (Plate 11.) This includes the three varieties known to lumbermen as the red, yellow, and white beeches. Frequent where found, but confined to the stream courses and the mouths of ravines; rare elsewhere, on knob sides and in lowland woods. Some large specimens occur, the largest being about two feet in diameter. Thriving young trees and saplings are very scarce or were overlooked. The species is too limited to have influenced my calculations.

CASTANEA DENTATA (Marsh.) Borkh. American Chestnut. (Plate 12.) Mostly confined to the knob sides, but appearing frequently over the lowlands. Much young stuff exists, often in patches, influencing much the following estimates. (The first vicinity below is entirely of very young growth, but has been temporarily trimmed out and may stand thus for two or three

PLATE 8.



HORNBEEAM
(Carpinus Caroliniana).

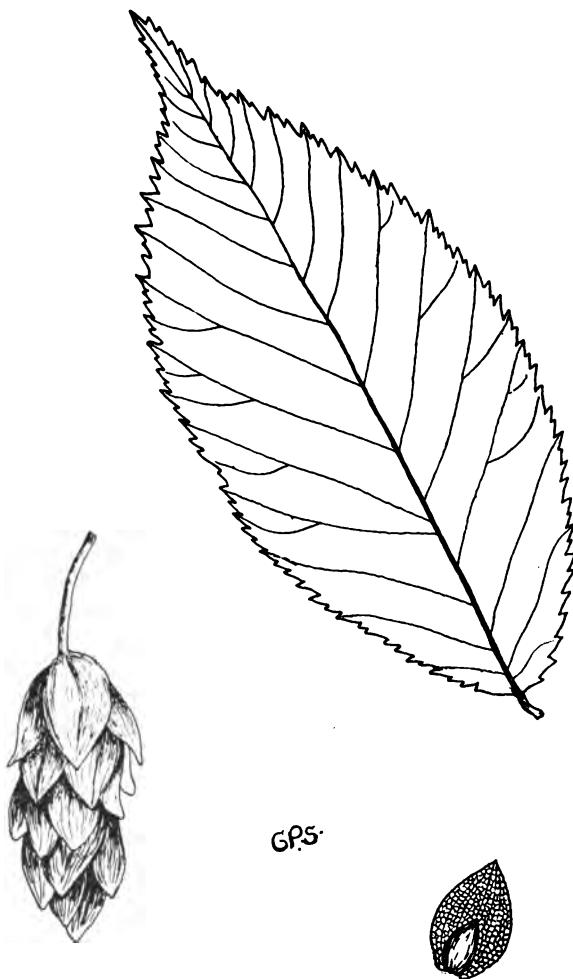
years, or even longer. All estimates are regardless of the relative size of the trees.)

Vicinity	78; 80	chestnuts out of 2,720 trees to the acre.							
"	74; 120	"	"	920	"	"	"	"	"
"	66; 10	"	"	100	"	"	"	"	"
"	999; 100	"	"	780	"	"	"	"	"
"	888; 40	"	"	380	"	"	"	"	"
"	444; 60	"	"	300	"	"	"	"	"
"	666; 20	"	"	500	"	"	"	"	"
"	98; 100	"	"	680	"	"	"	"	"
"	96; 10	"	"	210	"	"	"	"	"

QUERCUS RUBRA L. Red Oak. (Plate 13.) Very scarce; not over a half dozen specimens noted by me. Certainly one of the rarest oaks upon the reserve, but possibly more frequent than recorded. As with many of the oaks, the acorn is often quite necessary, or most helpful, for determining some specimens of this species. By reference to the drawing it may be seen that the cup of the acorn is very shallow, in relation to the width. The acorn is usually longer than wide and not more than one-third covered by the cup. Usually the leaf is near enough to the type to serve for ready recognition of the species.

QUERCUS PALUSTRIS Du Roi. Swamp or Pin Oak. (Plate 14.) Confined to the lowlands, mostly near the southern and eastern boundaries. Not at all common and, unless in fruit, easily confused with the scarlet oak, though the average leaf is somewhat darker green above. The cup of the acorn is of the same type as the red oak, but the acorn averages shorter in relation to the width. Having the red oak-pin oak style of cup, the shape and color of the leaves should enable one to differentiate between these two species. The red oak leaf is dull light green above, the pin oak darker and quite glossy. I consider the barks too much alike for use in discrimination, at least as far as Reservation specimens are concerned. I was told that the pin oak gets its name from the fact that its branches retain their original structure far into the center of the tree, the inner ends not fusing with the heart wood as ring after ring of tissue is added without, year by year. Thus, when the timber is cut and dried, these distinct inner ends of the branches shrink and,

PLATE 9.



HOP HORNBEAM
(Ostrya Virginiana).

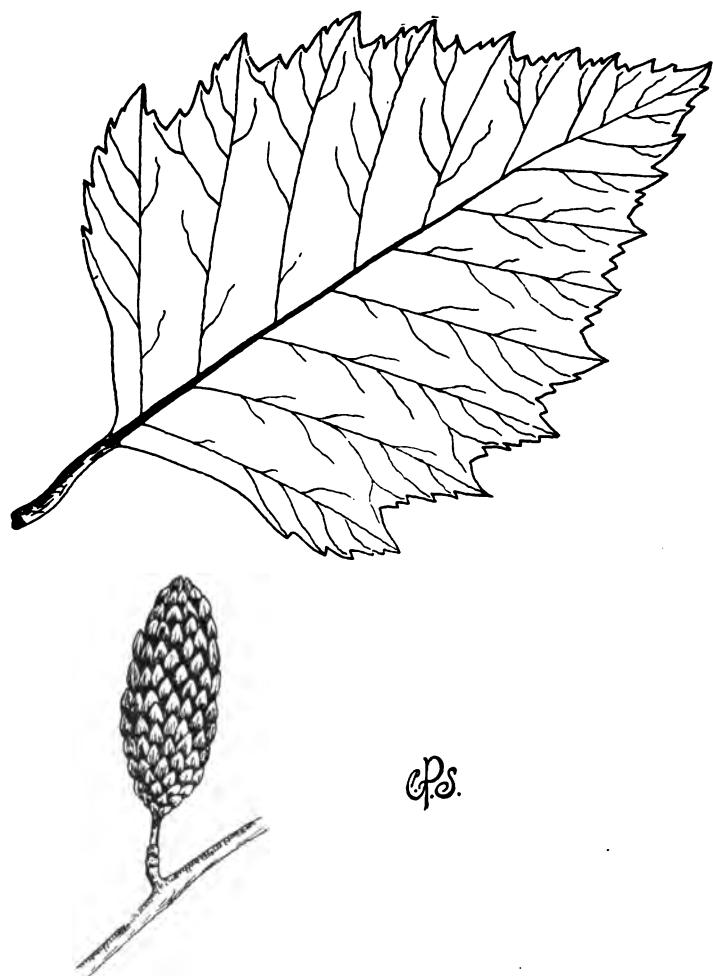
as pins, penetrate the logs from all directions, the sawed lumber, even some of the more inner planks, being abundantly supplied with "knotholes." The pin oak is somewhat more densely branched than the scarlet.

QUERCUS COCCINEA Wang. Scarlet Oak. (Plate 15.) Very abundant, and, in my judgment, the most valuable timber tree upon the Reservation, because of its adaptability to the conditions existing there at present. Common almost everywhere, from fine, large "two-foot" specimens down through all sizes. Common on the knobs, as well as in the lowlands. The following figures may be of interest:

Vicinity	82; 7 scarlet oaks out of	945 trees to the acre.
" 78; 320	" "	2,720 "
" 72; 175	" "	770 "
" 56; 165	" "	830 "
" 54; 63	" "	430 "
" 86; 46	" "	520 "
" 88; 30	" "	650 "
" 92; 80	" "	420 "
" 94; 20	" "	300 "
" 222; 100	" "	360 "
" 555; 20	" "	540 "
" 666; 100	" "	500 "
" 777; 20	" "	420 "
" 999; 30	" "	780 "
" 98; 100	" "	680 "
" 96; 80	" "	210 "
" 32; 80	" "	380 "
" 36; 200	" "	420 "
" 38; 200	" "	500 "
" 42; 200	" "	540 "
" 64; 240	" "	580 "

The recognition of the scarlet oak upon the Reservation is not difficult, since the pin oak is so uncommon and limited in distribution. However, the leaves vary from the lighter green of the red oak to the darker tint of the pin oak, and for doubtful specimens the most important move is to secure the acorn. The cup of the acorn is quite different from the red oak—pin oak type, being about twice as deep in proportion to the width (see plate). The acorn itself may vary from somewhat longer to shorter than wide, being two-thirds to one-half covered by the

PLATE 10.



RED BIRCH
(*Betula nigra*).

cup. The inner bark of this, and the two preceding oaks, is a pale pinkish-brown in color, commonly exposed by the shallow fissures in the outer bark. Absent from vicinities 888, 444, etc.

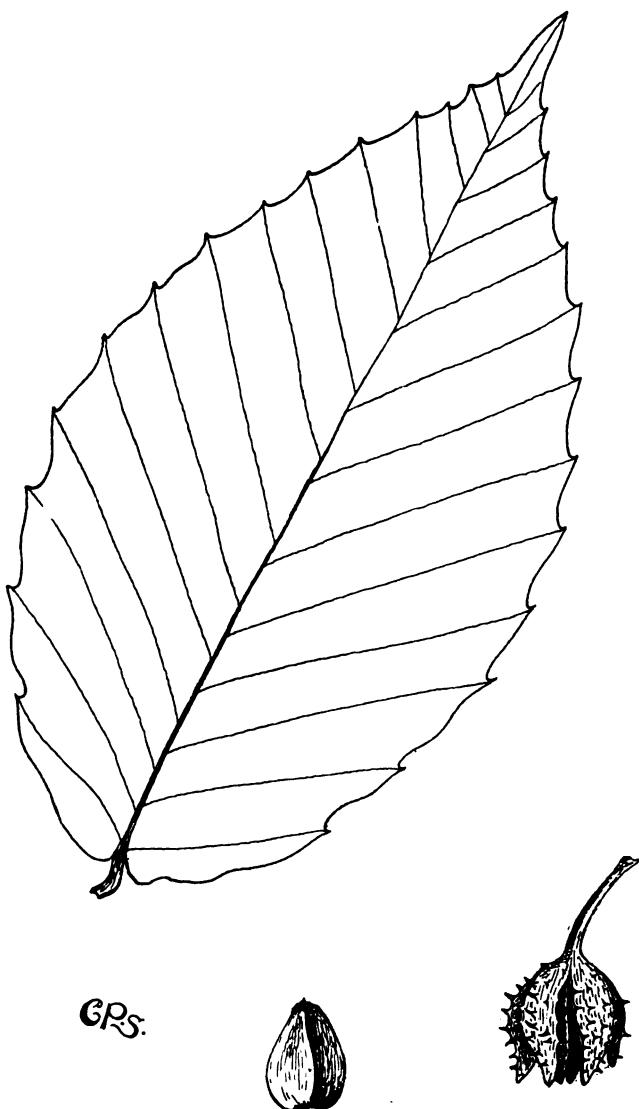
QUERCUS VELUTINA Lam. Black Oak. Quercitron. (Plate 16.)

The fourth oak in point of numbers. Very close to the scarlet as to adaptability, development, general distribution, and value. Relative abundance and distribution are both shown by the following table:

Vicinity	62;	60	black oaks	out of	500 trees to the acre.
"	64;	80	"	" "	580 " " " "
"	58;	60	"	" "	600 " " " "
"	42;	160	"	" "	540 " " " "
"	38;	160	"	" "	500 " " " "
"	36;	80	"	" "	420 " " " "
"	28;	20	"	" "	380 " " " "
"	96;	20	"	" "	210 " " " "
"	98;	100	"	" "	680 " " " "
"	666;	20	"	" "	500 " " " "
"	555;	60	"	" "	540 " " " "
"	222;	60	"	" "	360 " " " "
"	888;	20	"	" "	380 " " " "
"	444;	20	"	" "	300 " " " "
"	66;	50	"	" "	100 " " " "
"	94;	20	"	" "	300 " " " "
"	92;	20	"	" "	420 " " " "
"	88;	105	"	" "	650 " " " "
"	86;	45	"	" "	520 " " " "
"	54;	35	"	" "	430 " " " "

The outer bark of this species is quite black, rough and furrowed, but not exposing the rich orange or yellow inner bark. This last characteristic is quite constant and can be relied upon to determine specimens of extreme leaf variation. The black oak can usually be readily recognized by the large coarse leaf, four types of which are shown in the drawing. The upper right-hand type is abundant on sapling growth, the lower left-hand type being the most common form on the average well-started and larger trees. The upper left-hand figure represents the variations towards certain red oak and scarlet oak types which make advisable a test upon the inner bark. This third form is frequent on the older trees. The fourth form, that

PLATE 11.



C.P.S.

BEECH
(*Fagus Americana*).

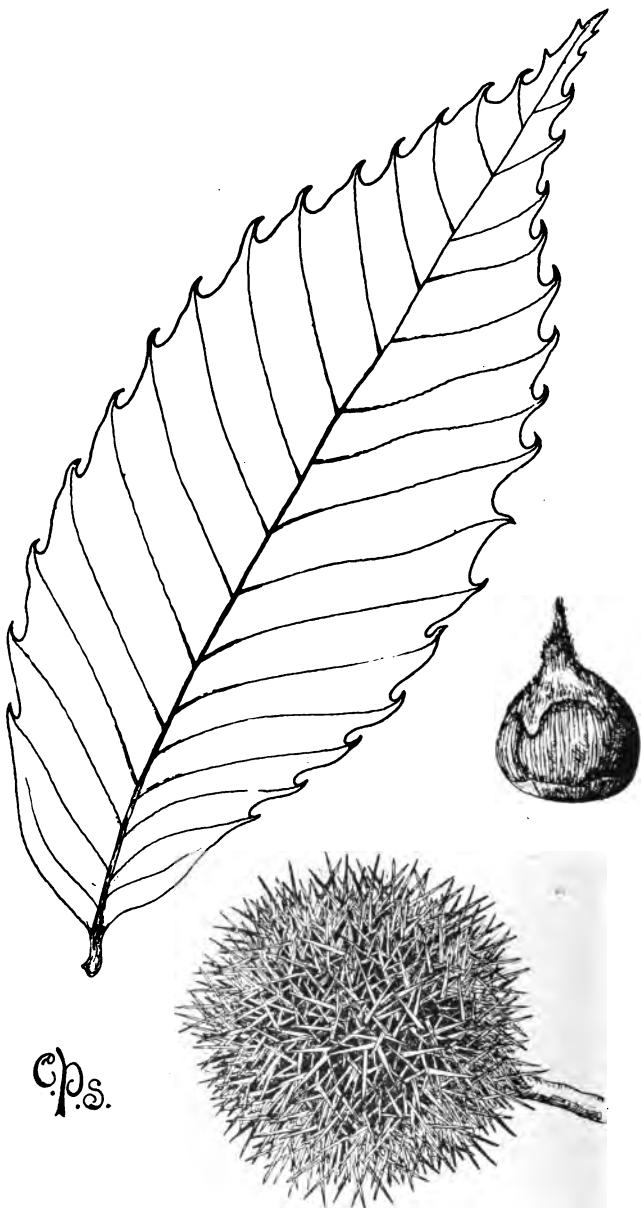
of the lower right-hand corner, suggests an extreme of the Spanish oak (not found upon the Reservation); but the outer and inner bark both prove it to be black oak, or at least a hybrid of this species. Only four or five trees, with this distinctly marked type of leaf, were found upon the Reservation; and one fine large specimen was noted in Scott County. This form of the black oak, if not a hybrid, certainly deserves sub-specific recognition. Acorn and cup scarcely distinguishable from those of the scarlet oak.

QUERCUS MARYLANDICA Moench. Barren Oak. Black Jack. (Plate 17.) Quite frequent in the area marked off by me as the "Barren Oak region," the most barren portion of the lowlands, as well shown by the plant life. Always associated with the post oak, which, however, has a more extended range upon the Reservation. The black jack is also occasional upon sterile knob sides. It is a dwarfish rough-barked tree with contorted boughs; seldom over one foot in diameter and twenty feet high, its thick, peculiar shaped, and exceedingly glossy leaves making its determination easy. Where found commonly, its ratio is about 40 trees amidst some 520 trees, all told, to the acre.

QUERCUS IMBRICARIA Michx. Shingle Oak. (Plate 18.) Also called peach-leaved and laurel oak, the latter term being objectionable, however, because of its application to a different species of the eastern mountains. The leaf of this oak readily distinguishes this species from all other Reservation oaks. It is scarcely more common than the red and swamp white oaks, being confined to the southeastern portions. One fine, large, well-rounded specimen and a half-dozen or more small ones exist along the stream near Mr. Richard Enlow's house. Further, occasional scattered specimens were noted in vicinities 24, 28, and 54.

QUERCUS ALBA L. White Oak. (Plate 19.) The most abundant oak upon the Reservation, indeed not equaled by any species. Several apparent hybrids were noted, some judged to be *Q. ALBA* x *Q. PRINUS* and *Q. ALBA* x *Q. PLATANOIDES*. As to relative abundance and distribution, the following table will speak:

PLATE 12.



CHESTNUT
(Castanea dentata).

Leaf three-quarters natural size.

Vicinity	82; 150 white oaks out of 945 trees to the acre.
" 78; 800	" " " " 2,720 "
" 76; 25	" " " " 900 "
" 72; 225	" " " " 770 "
" 56; 295	" " " " 830 "
" 54; 115	" " " " 430 "
" 24; 60	" " " " 180 "
" 26; 240	" " " " 300 "
" 28; 160	" " " " 380 "
" 32; 160	" " " " 380 "
" 36; 120	" " " " 420 "
" 38; 120	" " " " 500 "
" 42; 120	" " " " 540 "
" 48; 60	" " " " 180 "
" 64; 120	" " " " 580 "
" 62; 140	" " " " 500 "
" 58; 300	" " " " 600 "
" 66; 10	" " " " 100 "
" 86; 20	" " " " 520 "
" 88; 75	" " " " 650 "
" 666; 20	" " " " 500 "
" 222; 40	" " " " 360 "
" 999; 10	" " " " 780 "

Absent or only occasional in vicinities 888, 444, 92, 94, and 68. The leaves show little variation except in the depth of the sinuses, the two types in my drawing not doing full justice to the range of variation. The leaf, regardless of variations, usually will identify the tree without question; or the light gray scaly bark will serve, equally as well, for ready recognition.

QUERCUS MINOR (Marsh.) Sarg. Post Oak. Iron Oak. (Plate 20.) Common in the driest woods of the lowlands. As already said, always an associate of the barren oak, but more widely distributed and more abundant.

Vicinity	24; 30 post oaks out of 180 trees to the acre.
" 54; 14	" " " " 430 "
" 56; 68	" " " " 830 "
" 72; 40	" " " " 770 "
" 58; 40	" " " " 600 "
" 62; 40	" " " " 500 "

Mentioned from vicinities 28 and 88. This oak is easily recognized by the shape of the leaves, which, though dulled when put beside those of the barren oak, are more glossy than those

PLATE 13.



RED OAK
(*Quercus rubra*).

of any other of the Reservation oaks. No trees were noted over forty feet high or eight inches in diameter, the average being much less. The shaft is fairly straight and slender, the branching being of white oak type. The bark is more deeply furrowed than that of the white oak and is characterized by a decided checking of the longitudinal ridges.

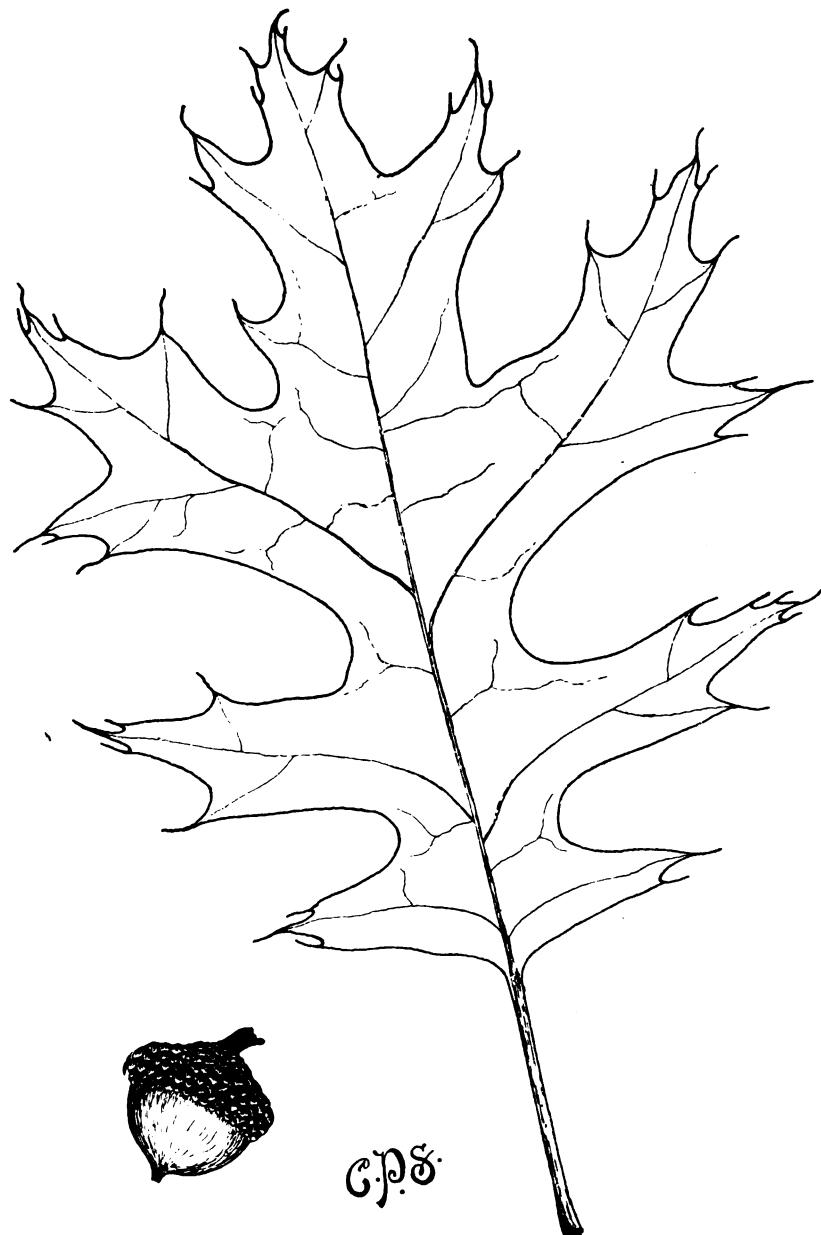
QUERCUS PLATANOIDES (Lam.) Sudw. Swamp White Oak. (Plate 21.) This oak is called "bur oak" about Henryville. Its importance and distribution upon the Reservation can be given in a few words. One small- and one medium-sized tree were noted along the stream through vicinity 54; and a group of some twelve or fifteen young trees are along the water course in vicinity 28. Not found elsewhere. Easily separated from the rock chestnut oak by the cup and long pedicel of the acorn.

QUERCUS PRINUS L. Rock Chestnut Oak. (Plate 22.) Abundant in the knob region and extending somewhat out upon the lowlands. As far as I could determine, this is the only chestnut oak upon the Reservation. It can be easily recognized. A table may be given for this species.

Vicinity	999; 120	chestnut oaks out of	780 trees to the acre.
"	777; 140	" " "	420 " " "
"	666; 160	" " "	500 " " "
"	555; 300	" " "	540 " " "
"	222; 60	" " "	360 " " "
"	98; 200	" " "	680 " " "
"	96; 80	" " "	210 " " "
"	94; 60	" " "	300 " " "
"	92; 160	" " "	420 " " "
"	88; 160	" " "	650 " " "
"	86; 123	" " "	520 " " "
"	84; 520	" " "	1,540 " " "
"	82; 410	" " "	945 " " "
"	78; 160	" " "	2,720 " " "
"	76; 175	" " "	900 " " "
"	74; 60	" " "	920 " " "
"	66; 10	" " "	100 " " "
"	64; 100	" " "	580 " " "
"	62; 100	" " "	500 " " "
"	56; 35	" " "	820 " " "
"	42; 40	" " "	540 " " "

Much of this abundance is due to sapling growth. The older trees vary from tall straight-shafted trees to low, spreading, stunted specimens with twisted, knotted stems and gnarled

PLATE 14.



PIN OAK
(Quercus palustris).

branches. The leaf characters, excepting the width, are very constant and, in my judgment, easily determine all Reservation chestnut oaks to be of the species, *Q. Prinus. L.*, without question. However, this species seems to be unrecorded from Indiana, since Dr. Coulter recalls the record for Tippecanoe County. I have recently examined living specimens of *QUEERCUS ACUMINATA* (Michx.) Sarg. and of *Q. ALEXANDERI* Britton, and am satisfied that my determination of the Reservation chestnut oaks, as recorded, is correct.

Before leaving the oaks, I will insert a condensed table showing the relations of the five common oaks to each other and of

Vicinity.	Scarlet.	Black.	White.	Post.	Chest-nut-	Total Five Oaks.	Total All Others.
24	30	30	60	30	.....	150	80
26	40	20	240	.....	.....	300	.....
28	40	20	160	.....	.....	220	160
32	80	40	160	.....	.....	280	100
34	.....	60	20	.....	.....	80	240
36	200	80	120	.....	.....	400	20
38	200	160	120	.....	.....	480	20
42	200	160	120	.....	40	520	20
48	40	40	60	.....	.....	140	40
52	100	120	140	.....	.....	360	180
54	63	35	115	14	.....	227	208
56	165	95	295	68	35	658	172
58	160	60	300	40	M	560	40
62	100	60	140	40	100	440	60
64	240	80	120	.....	100	540	40
66	10	50	10	.....	10	80	20
68	M	10	M	.....	.....	10	110
72	175	70	225	40	.....	510	260
74	.....	80	40	.....	60	180	740
76	80	80	25	.....	175	360	540
78	320	320	800	.....	160	1,600	1,120
82	7	20	150	.....	410	587	358
84	M	140	400	.....	520	1,060	480
86	46	45	20	.....	123	294	288
88	30	105	75	.....	160	370	280
92	80	20	M	.....	160	260	160
94	20	20	.....	.....	60	100	200
96	80	20	.....	.....	80	180	30
98	100	100	M	.....	200	400	280
222	100	60	40	.....	60	280	100
444	.....	20	20	.....	.....	40	260
555	20	60	M	.....	300	380	160
666	100	20	20	.....	160	300	200
777	20	20	M	.....	140	180	240
888	.....	20	M	.....	.....	20	360
999	30	60	10	.....	120	210	570
Averages	80—	66+	111+	6+	88+	352	224



SCARLET OAK
(*Quercus coccinea*).

Leaves reduced to three-fourths natural size.

these oaks as a whole to the total of other trees, excluding, as before, the unimportant sassafras-dogwood-ironwood series. The averages resulting, however, should not be used to compute the total number of trees upon the Reservation, because the areas of the so-called "vicinities" are anything but uniform, and such should be quite uniform in order to give fair approximations.

ULMUS AMERICANA L. White Elm. Water Elm. (Plate 23.)

Common along the water courses and in the ravines. Of no great importance as far as timber is concerned, though a few fine straight-shafted specimens occur along wooded streams. Leaves smaller and not rough above.

ULMUS FULVA Michx. Slippery Elm. (Plate 24.) Frequent along the waterways, and in ravines; occasional in woods. Easily known by the larger leaves, quite rough above. No large specimens were noted.

MORUS RUBRA L. Red Mulberry. (Plate 25.) Occasional under almost all soil conditions, mostly as stray saplings. No cut-leaved specimens noted. One medium-sized tree is near the southwestern corner.

LIRIODENDRON TULIPIFERA L. Tulip Tree. (Plate 26.) This is the "poplar" or "yellow poplar" of the Hoosier people, but is really a magnolia. It is frequent along the Reservation's water-courses, in the ravine openings, and in the richer portions of more open woodland. Not common enough to be considered in my calculations, but recorded from these vicinities: 22, 54, 32, 68, 74, 999, 888 and 444.

ASIMINA TRILoba (L.) Dunal. North American Papaw. More or less frequent along some streams and in the large ravine openings. Noted but once or twice.

SASSAFRAS, SASSAFRAS (L.) Karst. Sassafras. Ague Tree. (Plate 27.) Very abundant, forming many copses in thickets and along borders of woodland, and variously found in woods as well-formed trees, two to six inches in diameter. One tree, about twenty-five feet high and one foot in diameter, is upon the Hollister knob.

LIQUIDAMBAR STYRACIFLUA L. Sweet Gum. Red Gum. Frequent in ravines, along streams and in low richer areas of woodland. In one small area, vicinity 68, a corner missed

PLATE 16.



BLACK OAK
(Quercus velutina).

Leaves reduced to one-half natural size.

by one of the fires, the sweet gum is two-thirds of the tree growth, the density rate being 120 trees to the acre. This growth contains many fine young trees, tall and slender, conical in shape. Not a few large stately trees of this species occur upon the Reservation.

PLATANUS OCCIDENTALIS L. Sycamore. Button-ball. Plane tree. (Plate 29.) Confined to the localities cited for the preceding. Not infrequent and in various stages of development, no trees over two feet in diameter being noted, however. Distribution, as limited, quite general.

MALUS CORONARIA (L.) Mill. American Crab Apple. (Plate 30.) Rather rare. Occasionally in dry areas, but mostly along water-courses at the edges of woodland.

AMELANCHIER CANADENSIS (L.) Medic. Service-berry. June-berry. (Plate 31.) Abundant at many places in the woodland, especially in the lowlands. Represented almost everywhere. The leaf is usually noticeable for the paleness of the under surface.

CRATAEGUS CRUS-GALLI L. Cockspur Thorn. (Plate 32.) Rare. One or two fair-sized trees were found along the stream at the corner of vicinity 22. I have no record of others, but probably this does not quite do justice to the distribution of the species.

CRATAEGUS ROTUNDIFOLIA (Ehrh.) Borck. Glandular Thorn. (Plate 33.) Occasional in woods, mostly as low bushes. Leaf narrowed at the base, mostly smooth, without pubescence.

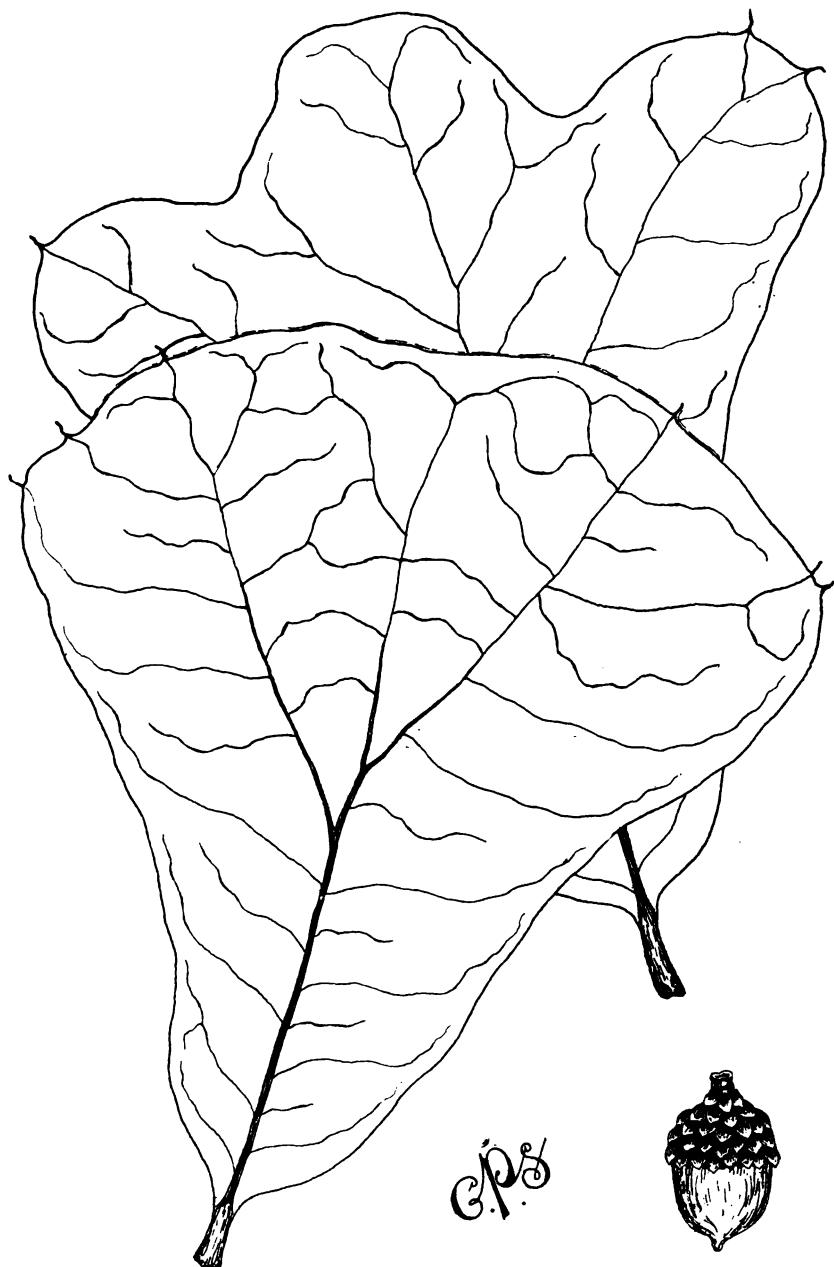
CRATAEGUS COCCINEA L. Red Haw. In woods or thickets, not common. Leaf scarcely narrowed, often heart-shaped, at base (see Plate 34), mostly smooth and without pubescence.

CRATAEGUS MOLLIS (T. and G.) Scheele. Red-fruited Haw. (Plate 34.) Occasional. Fruit hairy. Leaf not narrowed at base, pubescent on both surfaces.

CRATAEGUS TOMENTOSA L. Pear Haw. Rare. Leaf narrowed at base, rough above and pubescent below. Fruit duller red than in the others.

None of these four haws were found which had developed beyond the shrubby stage.

PLATE 17.



BARREN OAK
(Quercus Marylandica).

PRUNUS AMERICANA Marsh. Yellow Plum. Wild Red Plum.

(Plate 35.) Occasional in such places as frequented by the wild crab and associated with the same. Somewhat more common than the latter, but yet rare. Noted more than once.

PRUNUS SEROTINA Ehrh. Wild Black Cherry. (Plate 36.) Occasional at edges of woods, along streams and in ravine mouths. Not common.

CERCIS CANADENSIS L. Red-bud. American Judas-tree. (Plate 37.) Common in such situations as just recorded for the wild cherry.

GLEDITSIA TRIACANTHOS L. Honey Locust. (Plate 38.) Several small trees of this species, commonly known as "thorn tree," exist along the stream of the most western lowlands. Did not note it elsewhere.

ACER RUBRUM. L. Red, Scarlet, or Water Maple. (Plate 39.) Common in various sections, in the richer woodland. Its relations to the sum of its associates can be tabulated. The figures are largely due to small stuff, but some fair-sized trees occur.

Vicinity	34;	20 red maples out of	300 trees to the acre.
"	36;	20 "	420 "
"	38;	20 "	500 "
"	52;	20 "	540 "
"	54;	25 "	430 "
"	56;	10 "	830 "
"	66;	5 "	100 "
"	72;	77 "	770 "
"	76;	60 "	900 "
"	78;	160 "	2,720 "
"	84;	40 "	1,540 "
"	88;	10 "	650 "
"	444;	60 "	300 "

Also mentioned from vicinities 22, 28, 32, 48, 62, 64, 68, 222 and 666.

ACER SACCHARUM Marsh. Sugar Tree. Rock Maple. (Plate 40.) Frequent in the knob regions; especially conspicuous along the western boundary, as shown by the following table:

Vicinity	999;	250 sugar trees out of	780 trees to the acre.
"	888;	200 "	380 "
"	74;	40 "	920 "

PLATE 18.



SHINGLE OAK
(Quercus imbricaria).

Mentioned from vicinities 86 and 34. Some fine large specimens are in the ravine mouth "888," but most of the trees are sapling growth.

TILIA AMERICANA L. Bass-wood. American Linden. (Plate 41.) Two small trees stand in a cornfield north of Mr. Enlow's house. The field was woodland only a few years ago, and these two trees were spared at the request of Mr. Enlow. I believe this to be the limit of the species upon the Reservation.

CORNUS FLORIDA L. Flowering Dogwood. (Plate 42.) Super-abundant everywhere, mostly as unshapely shrubby stuff, but reaching large size and splendid development in the central-southern portion of vicinity 54, where it and the ironwood predominate. Some of the straight-shafted well-formed larger specimens should be spared when the section is cleared.

NYSSA SYLVATICA Marsh. Black Gum. Sour Gum. Tupelo. (Plate 43.) Quite common and widely distributed, not in sufficient numbers to much influence the general calculations, but frequently met with, as shown by the following list of mentioned vicinities: 22, 24, 32, 34, 36, 42, 54, 56, 58, 62, 66, 72, 74, 76, 84, 96, 444, 888, 999. Many fine large trees are present. The peculiar bark, checked deeply in the "alligator-skin effect," will readily identify the tree in winter.

DIOSPYROS VIRGINIANA L. Persimmon. Date Plum. (Plate 44.) Frequent in ravines, along roads and streams, and in dry thickets. Fruit, picked up from the ground under the trees, October 17, was as luscious and edible as if normally frost bitten; but that yet on the trees was found to be decidedly in need of a heavy frost.

FRAXINUS AMERICANA L. White Ash. Gray Ash. (Plate 44.) Common in the richer wooded tracts. Recorded from vicinities 54, 76, 88, 444 and 888. No large trees were noted. I sought for other species of this genus, but every tree examined was of this form.

PLATE 19.



WHITE OAK
(Quercus alba).

ANNOTATED LIST OF PLANTS

Known to Occur Upon the Reservation, Exclusive of Tree Forms Already Considered.

OSMUNDA CINNAMONEA L. Cinnamon Fern. A common fern in the rich shady ravines and somewhat ascending the slopes, where conditions are favorable; mostly, if not entirely, confined to the knob region.

ONOCLEA SENSIBILIS L. Sensitive Fern. Found mostly along with the preceding, but growing more in clumps.

DRYOPTERIS ACROSTICHOIDES (Michx.) Kuntze. Christmas Fern. In shady moist places in the ravines.

PHEGOPTERIS HEXAGONOPTERA (Michx.) Fée. Broad Beech-fern. Common. Found with the preceding forms.

ADIANTUM PEDATUM L. Maiden-hair Fern. Occasional, but not noted as common. All the ferns are indicative of moist, shady, rich soil.

ALISMA PLANTAGO-AQUATICA L. Water Plantain. Common in certain moist localities along streams, at the mouths of ravines, or wet low levels in the lowlands. Always in open places along water-ways.

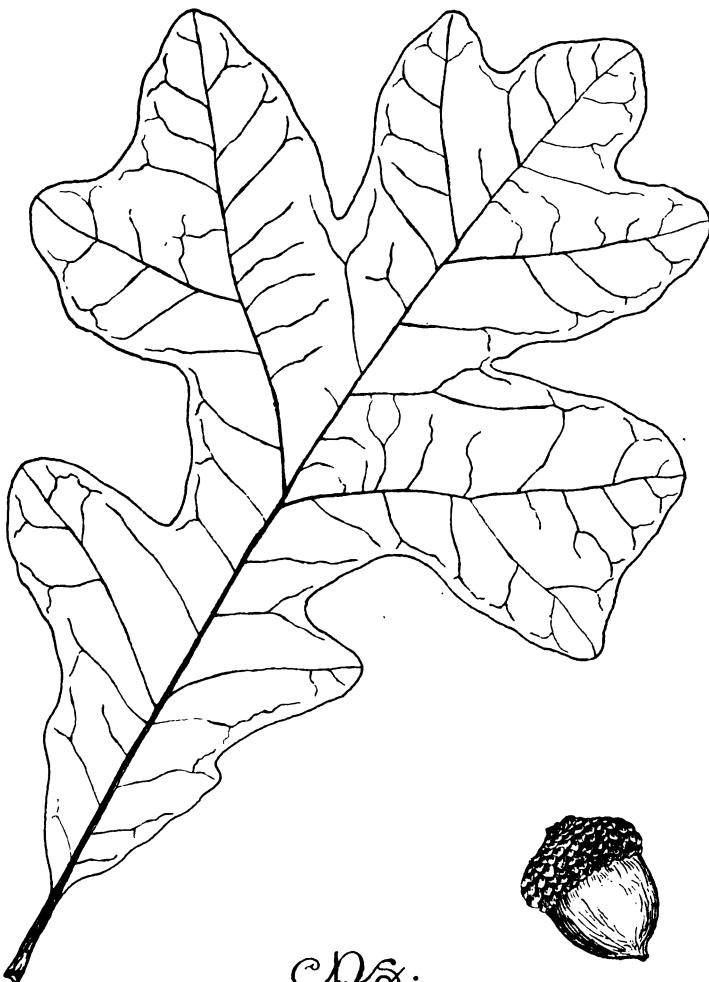
ANDROPOGON VIRGINICUS L. Virginia Beard-grass. Abundant and very generally distributed in dry soils, in woodland (the "barrens"), or open, in the lowlands and upon the knobs. More dominant in open places.

CHrysopogon AVENACEUS (Michx.) Beuth. Indian Grass. Apparently confined to the district designated as the Barren Oak region. Noted as not common and scattered.

SYNTHERISMA SANGUINALIS (L.) Nash. Crab-grass. Frequent in the vicinity of dwellings. Introduced.

PANICUM CRUS-GALLI L. Barn-yard Grass. Distribution as in the preceding, and also in moist soil along streams.

PLATE 20.



c.p.s.

POST OAK
(*Quercus minor*).

PANICUM MICROCARPON Muhl. Small-fruited Panicum. Quite common in the drier woods of the lowlands and also in the moist ravine-beds of the northwest corner.

PANICUM PORTERIANUM Nash. Porters' Panicum. Found in the drier woodland, especially along the wagon-ways.

IXOPHORUS GLAUCUS (L.) Nash. Yellow Foxtail. Millet. In cultivated fields and dry open places.

PHLEUM PRATENSE L. Timothy. In meadows and about the dwellings.

AGROSTIS PERENNANS (Walt.) Tuckerm. Thin-grass. Bottoms of the deeper ravines and borders of moist thickets.

AGROSTIS INTERMEDIA Scribn. Upland Bent-grass. Occasional on the dry, almost barren knob sides.

BROMUS CILIATUS L. Wood Chess. Found commonly on the shady, richer knob sides, especially well down into certain ravines.

BROMUS CILIATUS PURGANS (B. pubescens Muhl.) was taken along one of the streams.

ELYMUS VIRGINICUS L. Wild Rye. Mostly along the streams.

ELYMUS CANADENSIS L. Nodding Wild Rye. Also found along certain streams. Not noticed commonly.

HYSTRIX HYSTRIX (L.) Millsp. Bottle-brush Grass. Very common in the richer, moist ravines, extending somewhat up the ravine slopes and along streams and wagon paths away from the hills.

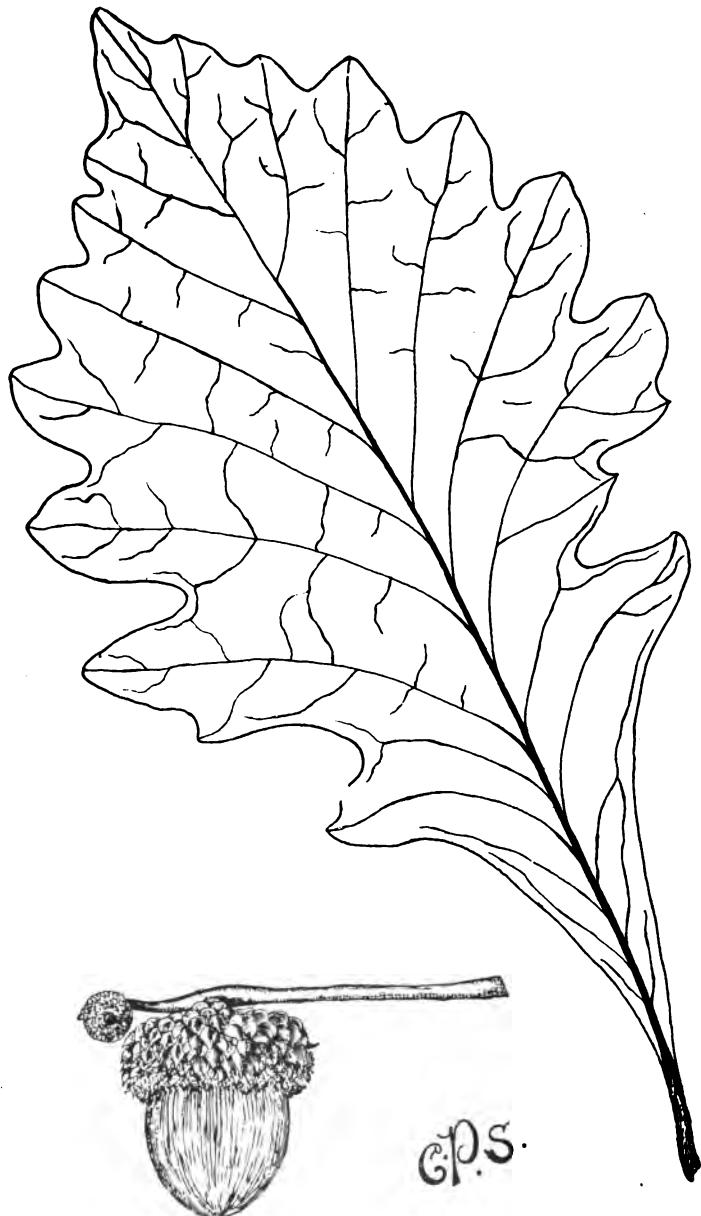
CYPERUS STRIGOSUS COMPOSITUS Britton. This form of the Straw-colored Cyperus is found in the wet low levels along the lowland streams. Probably other varieties also are to be found there.

SCIRPUS ATROVIRENS Muhl. Dark-green Bulrush. Abundant in low moist places along the water-ways of the opens.

SCIRPUS CYPERINUS (L.) Kunth. Wool Grass. Taken in the low moist area of the southwestern portion. One small patch there; not noted elsewhere.

CAREX BAILEYI Britton. Bailey's Sedge. Rather common in certain low moist places. Not recorded in Dr. Coulter's catalogue of the State flora. However, this sedge was carefully exam-

PLATE 21.



SWAMP WHITE OAK
(*Quercus platanoides*).

Leaf reduced to three-fourths natural size.

ined and determined, and has been taken by me elsewhere in the State.

CAREX FRANKII Kunth. Frank's Sedge. Very common in moist places in the opens of the lowlands.

CAREX SQUARROSA L. Squarrose Sedge. Found with the preceding. Not common.

ARISAEMA TRIPHYLLUM (L.) Torr. Jack-in-the-Pulpit. Indian Turnip. Common in moist, shady woodland.

JUNCUS EFFUSUS L. Common Rush. Another form of the moist levels along the streams; even in moist open places in the deeper ravines.

JUNCUS TENUIS Willd. Slender Rush. Common in moist open places and probably elsewhere.

JUNCUS MARGINATUS ARISTULATUS (Michx.) Coville. This well-marked variety of the Grass-leaved Rush is not reported from the State in Prof. Coulter's catalogue. It is very common in such localities as frequented by the last mentioned species.

VAGNERA RACEMOSA (L.) Morong. Wild Spikenard. Common along some of the streams and in the richer woods and shaded hillsides.

POLYGONATUM COMMUTATUM (R and S.) Dietr. Smooth Solomon's Seal. Frequent in such localities where the last species is found.

SMILAX GLAUCÀ Walt. Glaucous-leaved Greenbrier. Abundant in all neglected fields, rich or sterile, encroaching upon the borders of thickets and woods. Predominating as a form of the open. A nuisance in some cultivated fields.

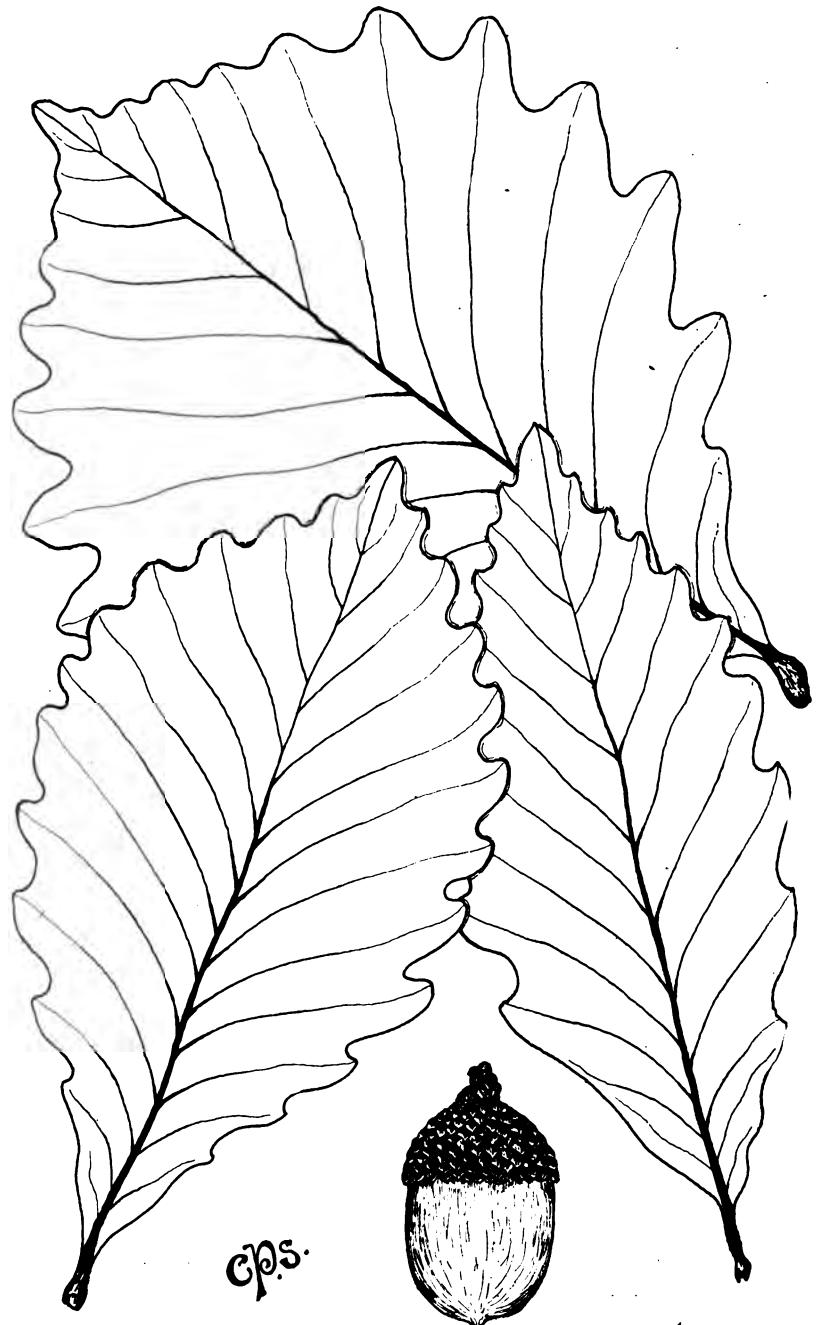
SMILAX ROTUNDIFOLIA L. Greenbrier. Horsebrier. The common Greenbrier of the woods and along streams. Generally indicative of rich soil.

AGAVE VIRGINICA L. False Aloe. A common plant of the dry barren areas. Found wherever the Barren Oak occurs and occasionally upon the tops of the knobs, in poor soil.

DIOSCOREA VILLOSA L. Wild Yam-root. A very common herbaceous climber of the richer shadier woodland, both of the lower levels and of the knob sides.

HABENARIA PSYCODES (L.) Gray. Purple-fringed Orchis. Not found by myself. Reported by Mr. Holton.

PLATE 22.



ROCK CHESTNUT OAK
(*Quercus Prinus*).

Leaves reduced to two-thirds natural size.

HABENARIA PERAMEMA Gray. Fringeless Purple Orchis. Found rather plentifully in the large open low place along the southern boundary, westwardly. This and the preceding always stand for rich soil.

CORYLUS AMERICANA Walt. Hazel-nut. In woodland, especially along streams, but locally only.

URTICASTRUM DIVARICATUM (L) Kuntze. Wood Nettle. Very common in the ravines between the knob ridges, also occasionally in moist places along the lowland streams.

ADICEA PUMILA (L.) Raf. Rich Weed. Very common in the deep ravines of the knob region and elsewhere along the streams.

BOEHMERIA CYLINDRICA (L.) Wild. False Nettle. Abundant, assorted with the two preceding species.

PARIETARIA PENNSYLVANICA Muhl. Pennsylvania Pellitory. Recorded by Mr. Holton. I have no knowledge as to its abundance or distribution.

PHORADENDRON FLAVESCENS (Pursh.) Nutt. Mistletoe. Reported by Mr. Holton.

ASARUM CANADENSE L. Wild Ginger. Another record of Mr. Holton's. Probably a plant of the richer knob sides.

RUMEX ACETOSELLA L. Sheep Sorrel. Very common in many of the dry open places. A rapidly spreading weed.

RUMEX CRISPUS L. Curled dock. Mostly in the vicinity of dwellings, in quite limited numbers.

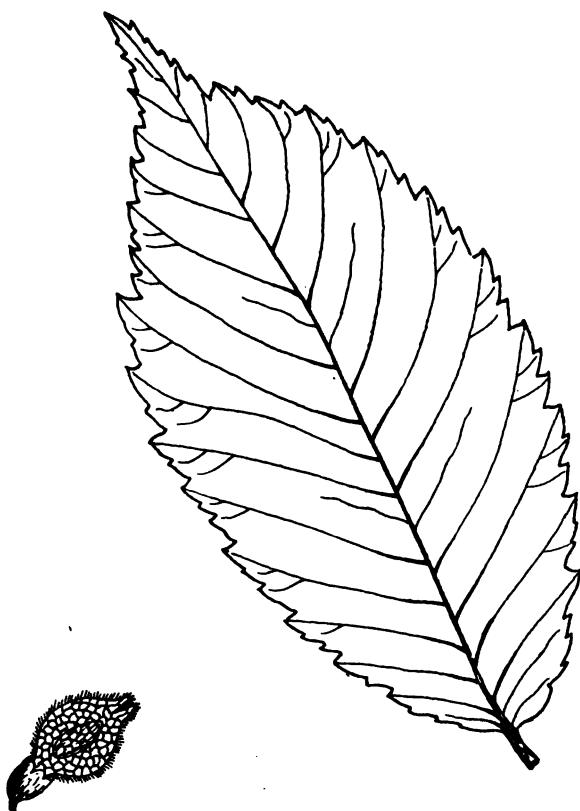
RUMEX OBTUSIFOLIUS L. Broad-leaved Dock. Associated with the last. Neither are doing much more than holding their own. Both will probably almost or quite disappear as the now waste and cultivated fields are planted in timber.

POLYGONUM PENNSYLVANICUM L. Pennsylvania Smartweed. Frequent and locally abundant in almost all moist places, along streams in the knob region (ravine beds) and lowlands, in wood and open; also about dwellings and in corn bottoms.

POLYGONUM PERSICARIA L. Lady's Thumb. Locally common, mostly about the dwellings or along the roadways.

POLYGONUM HYDROPIPER L. Water Pepper. Abundant in moist soil along the water-ways. Probably the most common smartweed on the Reservation.

PLATE 23.



C.P.S.

WHITE ELM
(*Ulmus Americana*).

POLYGONUM VIRGINIANUM L. Virginia Knotweed. Common along streams, in rich soil, and mostly within the shadows of woodland or thicket.

POLYGONUM AVICULARE L. Doorweed. Present in more or less abundance about the dwellings.

POLYGONUM ERECTUM L. Erect Knotweed. Recorded on authority of Mr. Holton.

POLYGONUM SCANDENS L. Climbing False Buckwheat. A common climber over the lower vegetation along the streams, especially in the knob region.

POLYGONUM SAGITTATUM L. Arrow-leaved Tear-Thumb. An almost constant associate of the Virginia knotweed, perhaps not so abundant in point of numbers, however.

POLYGONUM ARIFOLIUM L. Halberd-leaved Tear-Thumb. Reported by Mr. Holton, not found by me. Probably rare or local in its distribution.

CHENOPODIUM ALBUM L. White Goosefoot. Not common. Confined to the vicinity of houses.

CHENOPODIUM AMBROSIOIDES L. Mexican Tea. About Mr. Enlow's house. Of recent appearance but spreading rapidly.

AMARANTHUS RETROFLEXUS L. Rough Pigweed. Common about dwellings and in the bottom-land cornfields.

PHYTOLACCA DECANDRA L. Pokeberry. Common and well distributed, along streams in wood and open, in moist and dry places, in clearings and along edges of woodlands and thickets, also in the deepest ravines.

MOLLUGO VERTICILLATA L. Carpet Weed. About houses, especially on the Hollister knob. Overlooked by myself. Recorded on Mr. Holton's authority.

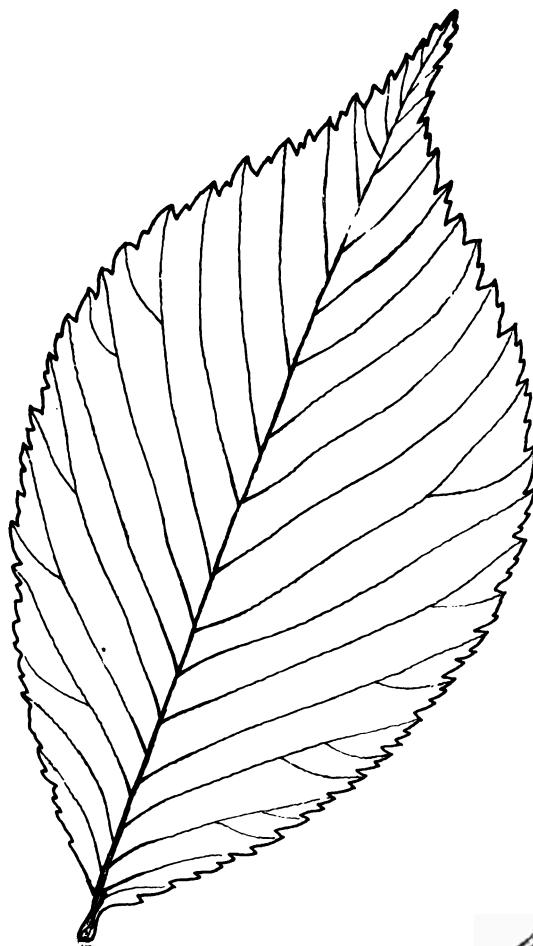
CLAYTONIA VIRGINICA L. and

CLAYTONIA CAROLINIANA Michx. Both Spring Beauties are reported by Mr. Holton. No trace of either came to my notice.

PORTULACA OLERACEA L. Purslane. Very common in certain low cornfields.

AGROSTEMMA GITHAGO L. Corn Cockle. Common on the Hollister knob. Not noted elsewhere.

PLATE 24.



G.P.S.



SLIPPERY ELM
(*Ulmus fulva*).

SILENE STELLATA (L.) Ait. Starry Campion. Noted but once, in a shady richer section of the lowland woods. Presumably one of the least common plants.

SILENE VIRGINICA L. Fire Pink. Reported by Mr. Holton.

SILENE ANTIRRHINA L. Sleepy Catchfly. Frequent in neglected open places, but not common.

HYDRASTIS CANADENSIS L. Yellow Root. Frequent, but becoming rare, once abundant, I was told. Found in shady moist rich woodland, on knob sides and in lowlands.

ISOPYRUM BITERNATUM (Raf.) T. & G. False Rue Anemone. Included on authority of Mr. Holton.

ACTAEA ALBA (L.) Mill. White Baneberry. Rare (?) on shady ravine sides.

AQUILEGIA CANADENSIS L. Wild Columbine. Noted by Mr. Holton. I found no traces of it.

ANEMONE VIRGINIANA L. Tall Anemone. Common in woodland along streams, especially in the ravines.

HEPATICA HEPATICA (L.) Karst and

HEPATICA ACUTA (Pursh.) Britton. Both Liverworts are reported as constituents of the early spring flora.

SYNDESMON THALICTROIDES (L.) Hoffmg. Rue Anemone. Another spring form not in evidence when my work began.

CLEMATIS VIORNA L. Leather Flower. Rare. Found in the deep ravines.

RANUNCULUS ABORTIVUS L. Kidney-leaved Crowfoot. Noted by Mr. Holton.

RANUNCULUS REGURVATUM Poir. Hooked Crowfoot. Rather common in moist shady places. Still in evidence during my stay upon the Reservation.

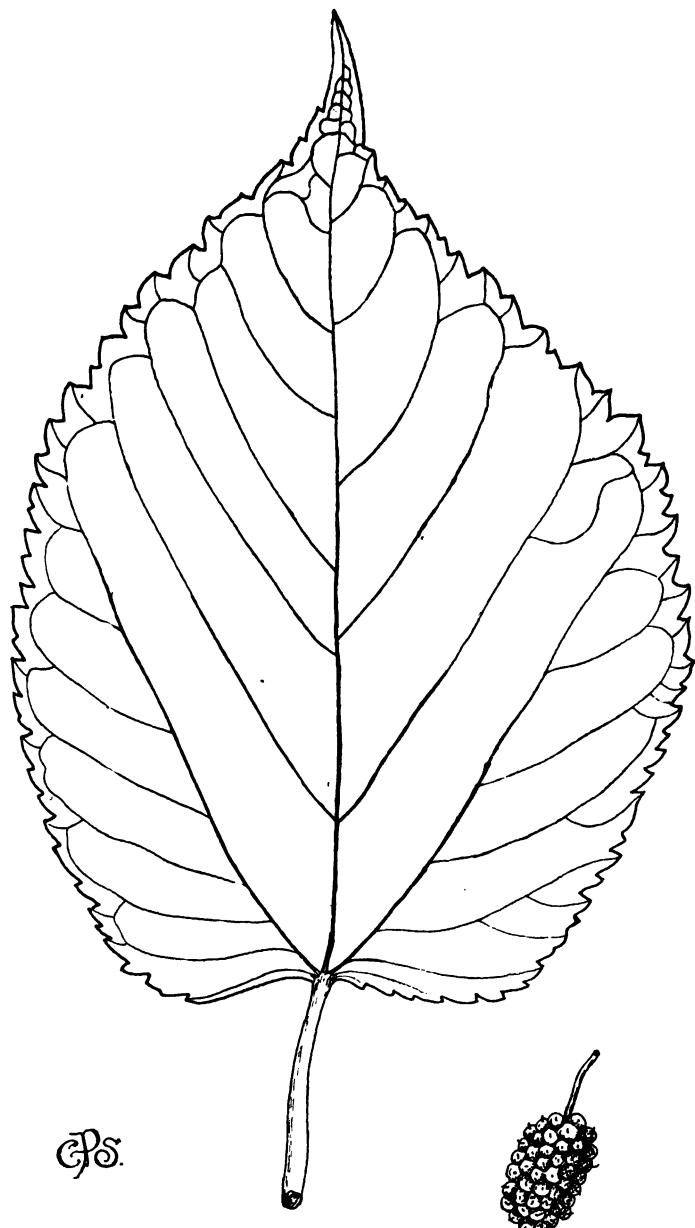
RANUNCULUS BULBOSUS L. Bulbous Buttercup. Recognized and reported by Mr. Holton.

RANUNCULUS SEPTENTRIONALIS Poir. Swamp Buttercup. Reported by Mr. Holton. No remnant of it noted by me.

THALICTRUM POLYGAMUM Muhl. Tall Meadow Rue. Occasional in moist open woods. Indicative of rich soil.

MENISPERMUM CANADENSE L. Moonseed. Commonly known in the surrounding territory, as "Sarsaparilla," its roots being used for medicinal purposes. Found very locally upon the Reser-

PLATE 25.



RED MULBERRY
(*Morus rubra*).

vation, along streams, especially in the larger ravines. A good indication of rich soil.

BENZOIN BENZOIN (L.) Coulter. Spice Bush. Not very common. Found along streams, mostly in the deep ravines.

SANGUINARIA CANADENSIS L. Bloodroot. Recorded by Mr. Holton.

BICUCULLA CUCULLARIA (L.) Millsp. and

BICUCULLA CANADENSIS (Goldie) Millsp. Both the Dutchman's Breeches and the Squirrel Corn are reported by Mr. Holton. These are among the spring plants which wither away and disappear very soon after ripening their seed.

LEPIDIUM VIRGINICUM L. Pepper-grass. About houses. Not much in evidence.

BRASSICA NIGRA (L.) Koch. Black Mustard. In waste places about the dwellings. Not common.

BRASSICA ARvensis (L.) B. S. P. Wild Mustard. Only a few plants noted, these being in neglected ground near an abandoned hut.

DENTARIA LACINIATA Muhl. Pepper-root. Noted by Mr. Holton.

BURSA BURSA-PASTORIS (L.) Britton. Shepherd's Purse. Vicinity of houses, in neglected ground, once cultivated.

POLANISIA GRAVEOLENS Raf. Clammy-weed. Another of Mr. Holton's records.

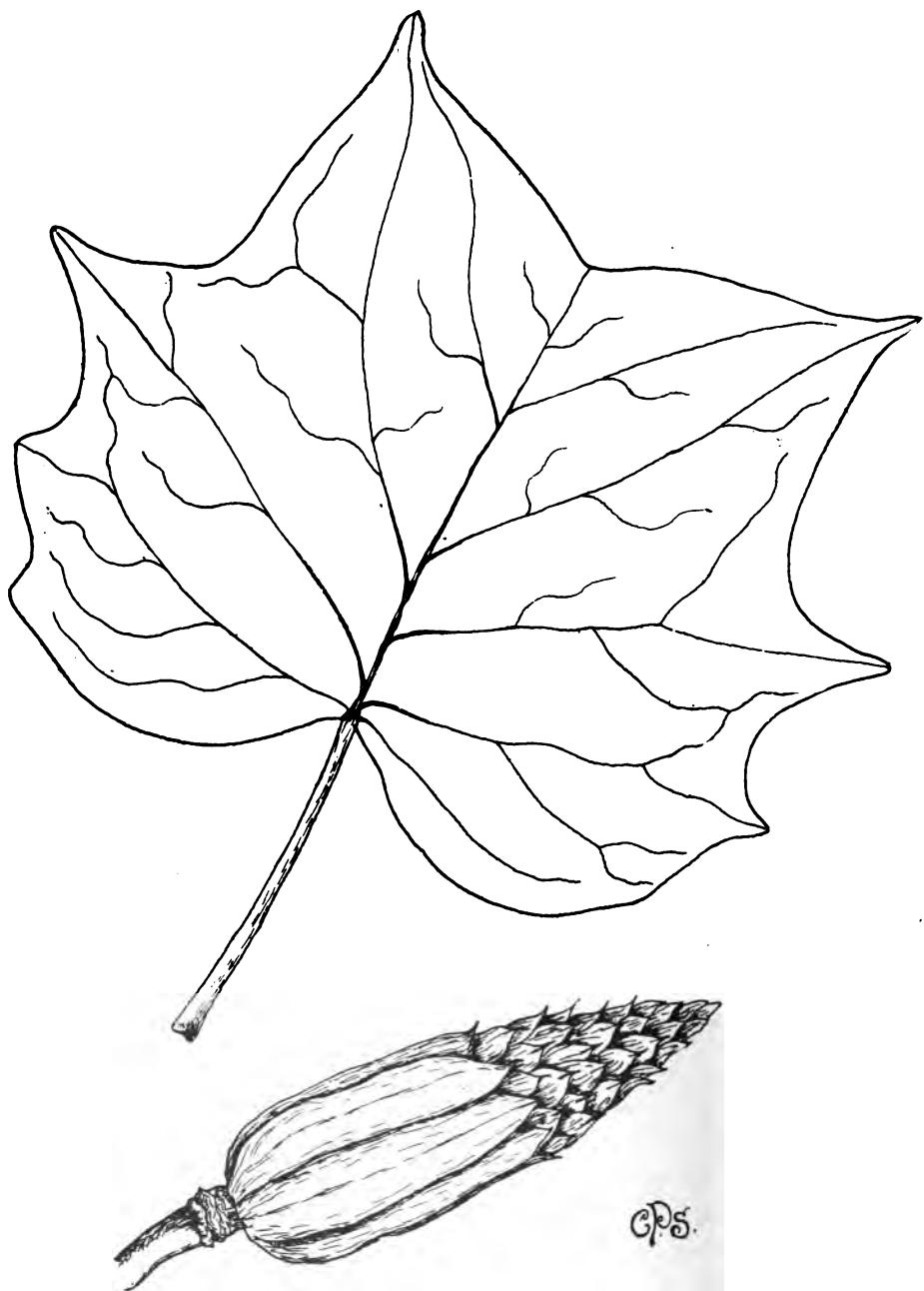
HEUCHERA AMERICANA Pursh. Alum-root. Common in the drier woodland, especially on the higher ridges; but not necessarily indicative of poor soil, though often growing in the poorest. Also in rich soil in the ravines.

HYDRANGEA ARBORESCENS L. Wild Hydrangea. Frequent in the bottoms of the deep ravines and probably frequent along streams of the northeastern boundary.

HAMAMELIS VIRGINIANA L. Witch Hazel. This shrub, becoming a well formed tree in the south and southwest, is strictly a shrub as represented upon the Reservation. It is confined to the deep hollows between the knobs and is not very common generally.

ARUNCUS ARUNCUS (L.) Karst. Goat's-beard. Rather rare. In the deep ravines and along streams. Not over six specimens noted.

PLATE 26.



TULIP OR YELLOW POPLAR
(*Liriodendron tulipifera*).

PORTERANTHUS STIPULATUS (Muhl.) Britton. American Ipecac.

Very common and well distributed in the drier, but not the most sterile, woodland of the Reservation both in the lowlands and extending well up upon the knobs.

RUBUS OCCIDENTALIS L. Black Raspberry. Reported by Mr. Holton. Said to be uncommon and very local.

RUBUS VILLOSUS Ait. High Bush Blackberry. Abundant in the lowlands and frequent in the ravine beds. Mostly confined to neglected fields, thickets, fencerows and roadsides, but frequently plentiful in certain wooded tracts. Quite variable.

RUBUS CANADENSIS L. Dewberry. Common in certain dry neglected opens.

POTENTILLA MONSPELIENSIS L. Rough Cinquefoil. Frequent in dry neglected or cultivated fields. Local in its distribution.

POTENTILLA CANADENSIS L. Five-finger. Super-abundant in the dry neglected clearings, especially in the central and south-western portions. Covering the ground in matted stretches, often almost excluding all other plants during this plant's period of active growth.

GEUM VERNUM (Raf.) T. & G. Spring Avens. Reported by Mr. Holton. Probably common. Disappears early in June.

GEUM CANADENSE Jacq. White Avens. Common in the richer soils, especially along streams and in the large ravines. Some specimens of this form usually persist throughout the winter.

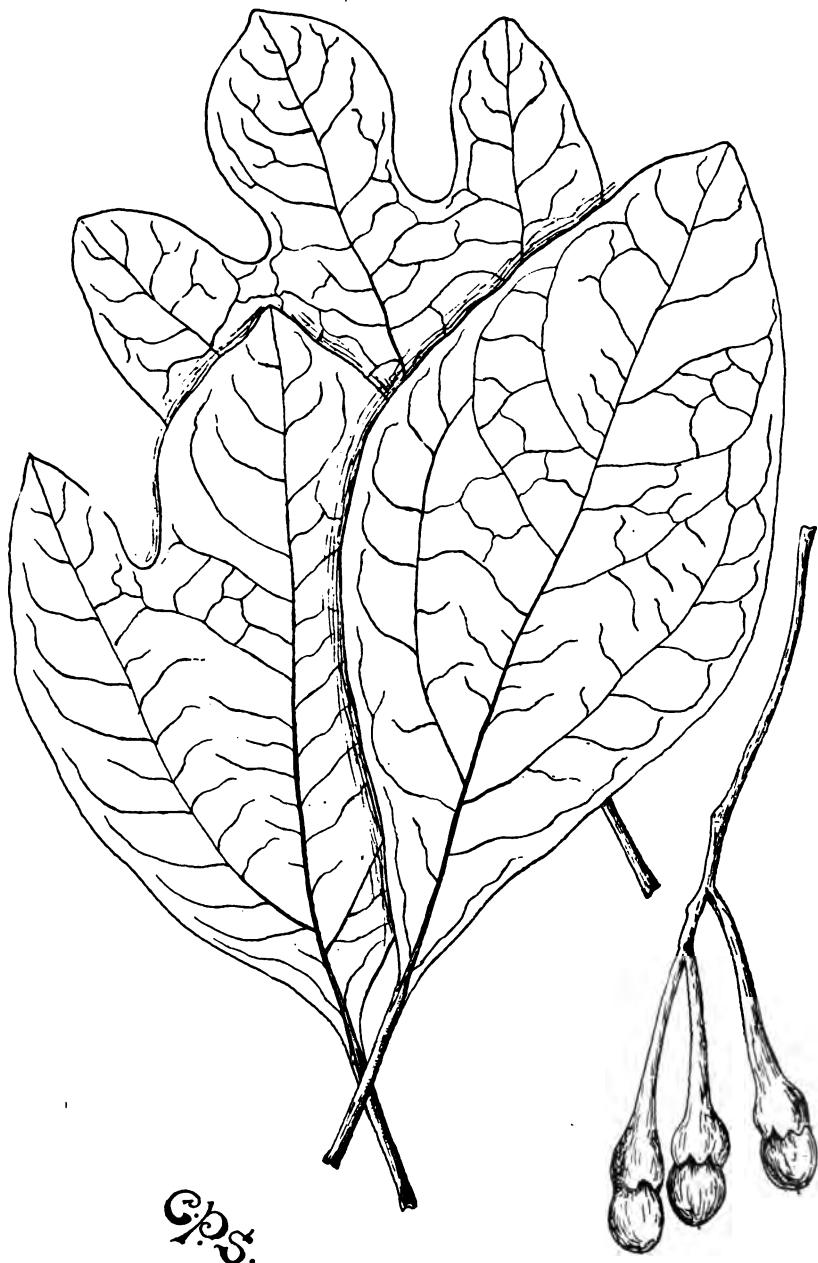
AGRIMONIA MOLLIS (T. & G.) Britton. Soft Agrimony. Common in the drier woods and thickets, especially eastwardly.

AGRIMONIA PUMILA Muhl. Small-fruited Agrimony. Not as common as the preceding. Found in similar situations and within the same range. Not reported in the catalogue of the State flora, but recorded from Kentucky by Britton and Brown.

AGRIMONIA PARVIFLORA Soland. Small-flowered Agrimony. Rather common in moist spots in the beds of ravines in the rolling and knob portions of the northern boundary. Not noted elsewhere.

ROSA SETIGERA Michx. Climbing Rose. Reported as rare by Mr. Holton.

PLATE 27.



SASSAFRAS
(*Sassafras Sassafras*).

ROSA HUMILIS LUCIDA (Ehrh.) Best. Common Wild Rose. Frequent in various situations and showing considerable variations. Mostly on the lowlands in dry soil.

CASSIA NICTITANS L. Sensitive Pea. Common, locally, in dry, poor soil; most commonly noted in a cornfield in the southeastern portion.

CASSIA CHAMAECRISTA L. Partridge Pea. More common than the latter, in dry sterile soil, also in cornfields and stubble fields. This and the last species are good indicators of poor soil.

CASSIA MARYLANDICA L. Wild Senna. Common in the dry neglected open areas of the southwestern lowlands and also in moist soil along the streams. Distribution irregular. Not necessarily indicative of poor soil.

BAPTISIA LEUCANTHA Torr and Gray. Large White Wild Indigo. Common or rare in the dry barren timbered areas, the home of the Barren Oak. Here associated with the False Aloe, already mentioned, and with the Rattlesnake Master, **ERYNGIUM AQUATICUM**, to be mentioned later. In fact, these three species stand together as one of the most characteristic plant societies within the range of the Barren Oak.

In regard to my determination of this species I will say that I was unfortunate in not finding a late specimen yet in bloom. The plant had not been recorded by Mr. Holton and I could get no reliable information as to the color of the flowers. A close study of the foliage and fruit, fresh and dried, several times repeated, seems to leave no question as to the correct naming of the plant; but the species is recorded as found only in moist rich soil in lowlands, not at all the condition in which the Reservation representatives exist. It is certainly not **BAPTISIA ALBA** (L.) R. Br. reported from the knob region near New Albany, and, all things considered, I think it best to record it as *B. leucantha*, it possibly deserving sub-specific recognition.

TRIFOLIUM PRATENSE L. Common Red Clover. Variously distributed near dwellings.

PSORALEA PEDUNCULATA (Mill.) Vail. Samson's Snakeroot. In dry sterile soil. Not common; noted in two definite limited patches, along wagon roads.

PLATE 28.



SWEET GUM
(*Liquidambar styraciflua*).

Leaves three-fourths natural size.

CRACCA VIRGINIANA L. Cat-gut. Goat's-rue. Common as an erect bushy plant in dry soil upon the tops of the knob-ridges, especially from the Hollister knob to the Geodetic knob.

STYLOSANTHES BIFLORA (L.) B. S. B. Pencil Flower. Frequent within a very limited area, within the range of the Barren Oak. In dry soil along wagon ways. Associated with *Lespedza repens*. One of the rarest plants of the Reservation.

MEIBOMIA NUDIFLORA (L.) Kuntze. Naked-flowered Tick-trefoil. Can include this plant only on the authority of Mr. Holton.

MEIBOMIA GRANDIFLORA (Walt.) Kuntze. Pointed-leaved Tick-trefoil. Common in the richer woodland, especially on the more shaded knob sides.

MEIBOMIA MICHAUXII Vail. Prostrate Tick-trefoil. Frequent in the drier and shadier woods, but not in the Barren Oak belt.

MEIBOMIA SESSILIFOLIA (Torr.) Kuntze. Sessile-leaved Tick-trefoils. Common in dry open territory, invading thickets.

MEIBOMIA CANESCENS (L.) Kuntze. Hoary Tick-trefoil. One of the most common tick-trefoils upon the Reservation. Found in the opens, especially at the edges of woods and along streams.

MEIBOMIA BRACTEOSA (Michx.) Kuntze. Large-bracted Tick-trefoil. Only a few specimens noted. Found in dry soil of the opens, near or in open thickets.

MEIBOMIA PANICULATA (L.) Kuntze. Not observed by me; reported by Mr. Holton.

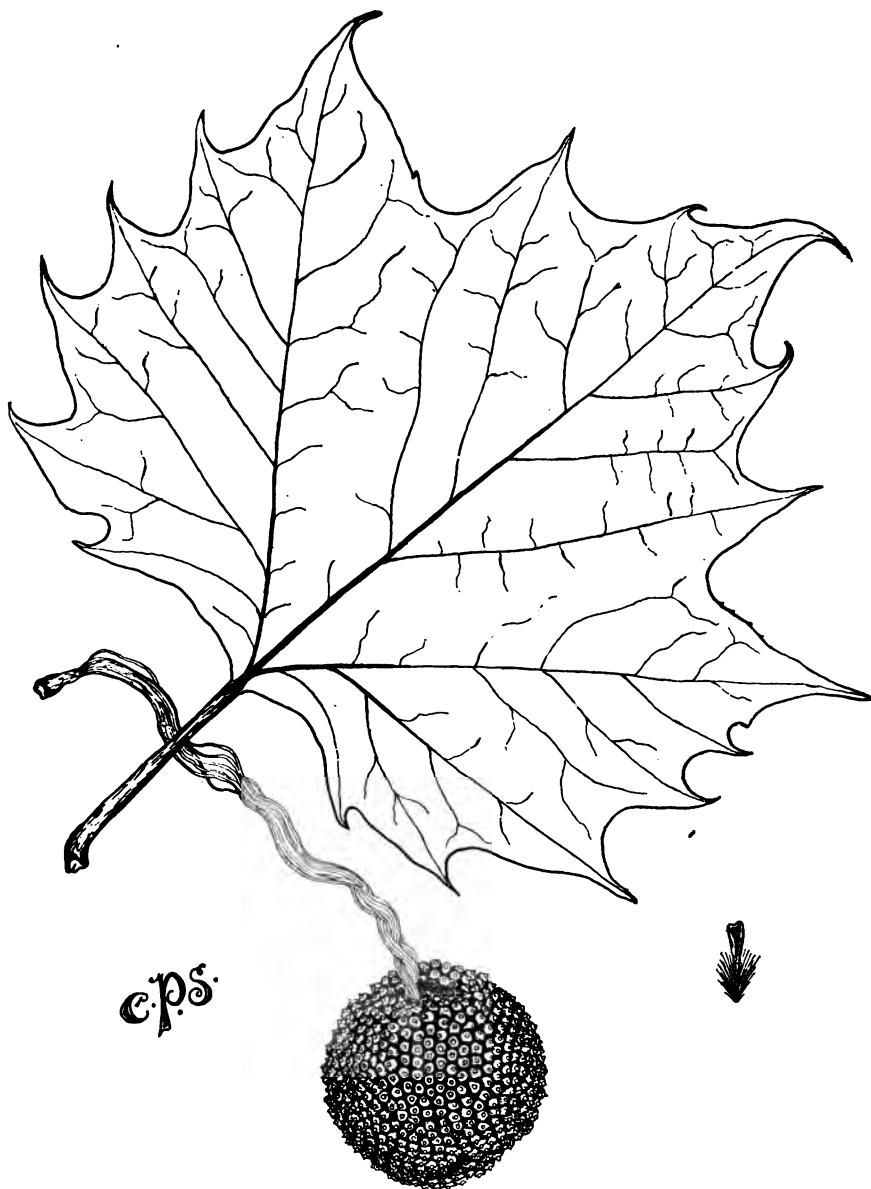
MEIBOMIA DILLENI (Darl.) Kuntze. Dillen's Tick-trefoil. A common plant in the drier woods and thickets where somewhat open.

MEIBOMIA MARYLANDICA (L.) Kuntze. Smooth Small-leaved Tick-trefoil. Common in dry open territory.

LESPEDEZA REPENS (L.) Bart. Creeping Bush-clover. Frequent in dry open places, especially along roads through the Barren Oak region. Limited in distribution.

LESPEDEZA PROCUMBENS Michx. Trailing Bush-clover. Much more common than the preceding and much more widely distributed, growing in dry and somewhat moist soil in thickets and open woods, in lowland and knob region.

PLATE 20.



SYCAMORE
(Platanus occidentalis).

LESPEDEZA VIOLENCEA (L.) Pers. Bush-clover. Common on the dry, more or less exposed, knob-sides and at the edges of the dry lowland woods.

LESPEDEZA FRUTESCENS (L.) Britton. Abundant in dry soil, in lowland and on the knobs, associated with the last where that form occurs.

LESPEDEZA HIRTA (L.) Ell. Hairy Bush-clover. Very common in dry soil, especially in the dry woods of the southern lowland portion.

The last three plants are strong indicators of dry, poor soil.

VICIA AMERICANA Muhl. American Vetch. Common in a richer stretch of shady woodland of the eastern central portion. Not noted elsewhere.

FALCATA COMOSA (L.) Kuntze. Hog Pea-nut. Frequent in moist shady woods.

APIOS APIOS (L.) MacM. Ground-nut. Reported by Mr. Holton.

PHASEOLUS POLYSTACHYUS (L.) B. S. P. Wild Bean. Common near the top, along the road up the Hollister Knob. Not noted elsewhere. A luxuriant climber or trailer.

STROPHOSTYLES UMBELLATA (Muhl.) Britton. Pink Wild Bean. Common in the dry neglected or stubble fields of the southwestern lowlands. An inconspicuous trailer. Indicative of poor soil.

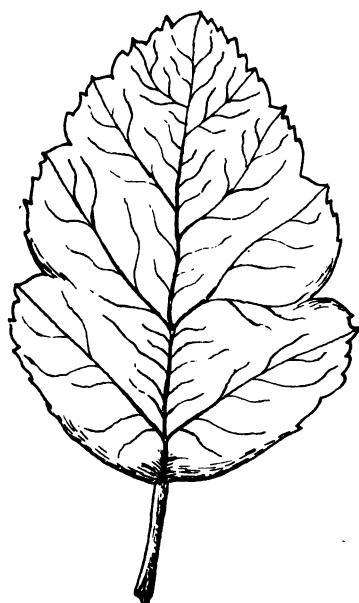
OXALIS STRICTA L. Yellow Wood-sorrel. Not at all generally distributed, but found at various points and in various conditions, generally in the open, moist or dry. Not indicative of any soil condition.

LINUM VIRGINIANUM L. Wild Yellow Flax. Frequent in dry woodland, especially in the "foot-hills" of the knobs.

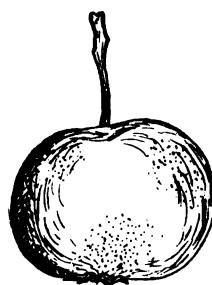
POLYGALA AMBIGUA Nutt. Loose-spiked Milkwort. Common in dry neglected openings at the foot of the Hollister Knob. Not noted elsewhere.

ACALYPHA GRACILENS Gray. Slender Three-seeded Mercury. Very common in many fields and waste places. The material handled carefully was of this species. Possibly my general recognition of this plant included **ACALYPHA VIRGINICA** L. also, but such was not handled or recognized.

PLATE 30.



G.P.S.



WILD CRAB APPLE
(*Malus coronaria*).

EUPHORBIA MACULATA L. Spotted Spurge. Frequent near dwellings, along some roads and in stubble fields.

EUPHORBIA NUTANS Lag. Upright Spotted Spurge. Very abundant in open places, corn fields and stubble fields especially.

EUPHORBIA COROLLATA L. Flowering Spurge. Very common, especially eastwardly, in opens, cornfields, neglected areas, along borders of woods and in open thickets. Mostly in dry soils.

EUPHORBIA COMMUTATA Eugelm. Tinted Spurge. An early spring form, disappearing in May or June. Reported by Mr. Holton.

RHUS COPALLINA L. Black Sumac. Abundant at the edges of woods, composing a large percentage of many thickets along streams and in opens, practically everywhere upon the Reservation.

RHUS GLABRA L. Scarlet Sumac. Common, but not as plentiful as the preceding. Distribution general.

RHUS RADICANS L. Poison or Three-leaved Ivy. Abundant everywhere as a trailer and climber.

EUONYMUS ATROPURPUREUS Jacq. Burning Bush. Wahoo. Occasional along streams. Noted but in one locality and that along the eastern boundary; but it probably occurs elsewhere in small numbers.

CELASTRUS SCANDENS L. Shubby Bittersweet. Not common, but possibly more so than my citation indicates. Found by me only along the stream of the extreme southeastern corner.

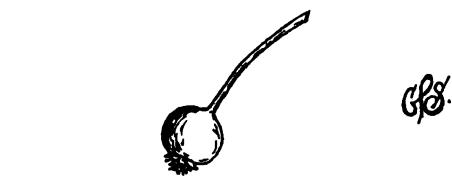
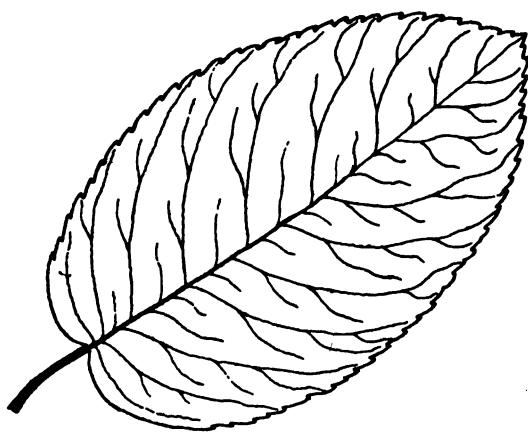
IMPATIENS BIFLORA Walt. Spotted Touch-me-not. This very delicate watery-stemmed plant is very common along all the streams and in moist places in the beds of the ravines.

CEANOHTHUS AMERICANUS L. New Jersey Tea. This shrub is very common on the tops and southern exposures of the knobs, especially the southern range. It is there in rich soil and doing most excellent service in holding the soil in place. This plant should be recognized and considered when removing or planting timber, etc.

VITIS LABRUSCA L. Fox Grape. Recorded by Mr. Holton as rare.

VITIS AESTIVALIS Michx. Summer Grape. Quite common and of very general distribution, being frequent in rich and dry

PLATE 31.



SERVICE BERRY
(Amelanchier Canadensis).

woods and thickets, as a climber; and covering considerable areas on barren untimbered knob sides, as a bushy trailer.

VITIS CORDIFOLIA Michx. Frost Grape. Frequent along streams, but of interrupted distribution.

PARTHENOCISSUS QUINQUEFOLIA (L.) Planch. Virginia Creeper. Five-leaved Ivy. Very common. Distribution strictly general.

MALVA ROTUNDIFOLIA L. Common Mallow. Confined to the vicinity of houses. Not common.

SIDA SPINOSA L. Pickly Mallow. Reported by Mr. Holton. Probably limited in distribution.

ASCYRUM HYPERICOIDES L. St. Andrews' Cross. Found frequently, here and there, in dry soil, especially along the wagon ways of the central lowlands.

HYPERICUM PROLIFICUM L. Shrubby St. John's-wort. Mr. Holton reports that at least one "bush" of this species exists on the Reservation. It is probably occasional along streams of the lowlands.

HYPERICUM MACULATUM Walt. Corymbed St. John's-wort. Very common in moist or dry soil, in open neglected places, along streams and roads in rich or poor soil.

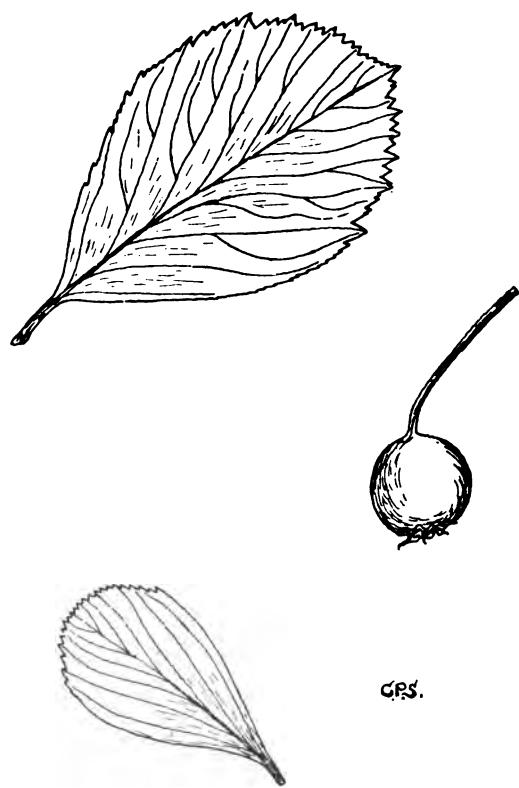
HYPERICUM MUTILUM L. Dwarf St. John's-wort. Abundant in moist meadows, where not crowded out by more vigorous forms. Distribution necessarily limited.

SAROTHRA GENTIANOIDES L. Pine Weed. One of the rarest plants on the Reservation, as also in the State. I found one lone specimen in the barren oak district and also a small limited patch in the dry sterile opens of the southwestern lowlands. A strong indication of poor soil.

LECHEA RACEMULOSA Michx. Oblong-fruited Pin-weed.

LECHEA TENUIFOLIA Michx. Narrow-leaved Pin-weed. These two barren-looking plants were found plentifully in sterile soil of the level territory south and west of the Slam place, and westward on dry exposed knob sides of southern exposure. These two plants have been carefully handled and the determination as given above is without question. Neither are given in Dr. Coulter's list of the State flora, but the range of each, as given by Britton and Brown, includes Indiana.

PLATE 32.



COCKSPUR THORN
(*Crataegus Crus-Galli*).

VIOLA PALMATA L. Blue Violet. Reported by Mr. Holton, as are also the following:

VIOLA OBLIQUA Hill. Common Blue Violet.

VIOLA SAGITTATA Ait. Arrow-leaved Violet.

VIOLA PUBESCENS Ait. Hairy Yellow Violet.

VIOLA CANADENSIS L. Canada Violet.

PASSIFLORA LUTEA L. Yellow Passion-flower. Undoubtedly upon the Reservation but not actually observed there. I found it commonly in a wheat stubble field just across the northern boundary and also in a thicket only a few yards south of the Reservation line.

PARSONIA PETIOLATA (L.) Rusby. Tar Weed. Reported by Mr. Holton.

LUDWIGIA ALTERNIFOLIA L. Rattle-box. Very common, at least in the lowlands of the southwestern corner. Mostly in moist places, but also in dry ditches and gutters along some roads.

EPILOBIUM COLORATUM Muhl. Purple-leaved Willow-herb. Found sparingly in low moist places along waterways.

ONAGRA BIENNIS (L.) Scop. Generally abundant in dry or moist soil, almost everywhere in open and neglected places. In the deep ravines it reaches a height of from five to eight feet, with looser foliage and inflorescence, the pods being smaller and comparatively much more slender.

KNEIFFIA FRUTICOSA (L.) Raimann. Sundrops. As far as noted, confined to open moist low grounds near the southeastern corner.

CIRCAEA LUTETIANA L. Enchanter's Night-shade. Frequent in the richer woods and thickets.

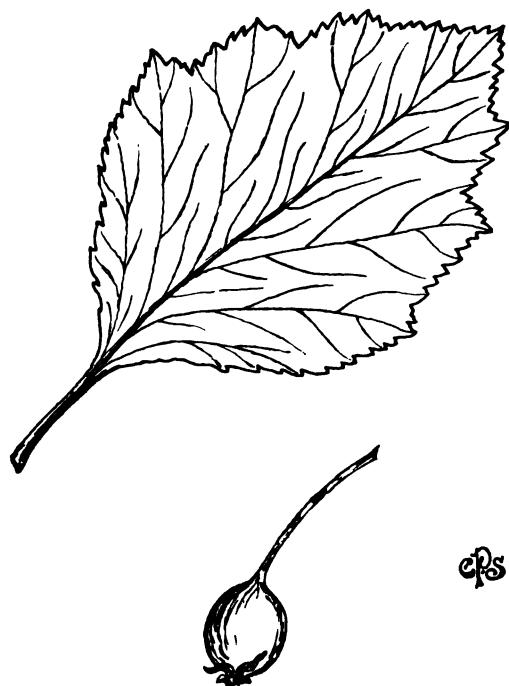
ARALIA SPINOSA L. Hercules Club. Frequent in rich sandy soil, where such occurs upon the knob sides. Principally limited to the southern exposure of the Hollister Knob and one of the northern slopes along the northern boundary. Probably doomed to extinction.

ARALIA RACEMOSA L. Spikenard. Occasional in rich soil along shaded streams.

PANAX QUINQUEFOLIUM L. Ginseng. Sang. Once common; now rare or occasional. In similar situations as the preceding plant.

DAUCUS CAROTA L. Wild Carrot. On the Hollister knob. Of recent introduction there and about Henryville. Several per-

PLATE 33.



GLANDULAR THORN
(*Crataegus rotundifolia*).

sons called my attention to this now common plant and remarked about its being a newcomer.

ANGELICA VILLOSA (Walt.) B. S. P. Pubescent Angelica. Frequent in dry soil locally, on knob sides and below. As far as I can learn, this is another new record for Indiana.

THASPIUM TRIFOLIATUM AUREUM (Nutt.) Britton. Occasional in moist soil along streams.

ERYNGIUM AQUATICUM L. Button Snakeroot. Rattlesnake-master. Very interesting as one of the three plants so characteristic of the Barren Oak region, as discussed above.

SANICULA CANADENSIS L. Short-styled Black Snakeroot. Common in the richer woods and thickets. Probably *S. MARYLANDICA* L. is included in my general survey of this plant, though all specimens examined closely were Canadensis.

WASHINGTONIA CLAYTONI (Michx.) Britton. Woolly Sweet Cicely. Frequent in the richer woodland, in lowlands or mouths of ravines.

WASHINGTONIA LONGISTYLIS (Torr.) Britton. Smooth Sweet Cicely. Occasional in similar situations.

CICUTA MACULATA L. Water Hemlock. Common along streams.

DERINGA CANADENSIS (L.) Kuntze. Honewort. Frequent in moist rich soil near waterways, in woodland.

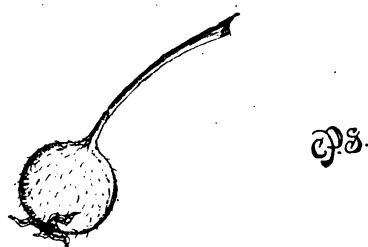
ERIGENIA BULBOSA (Michx.) Nutt. Pepper-and-salt. I found no trace of it, but Mr. Holton reports it. Known to some as "Harbinger of Spring."

GAYLUSSACIA FRONDOSA (L.) T. & G. Tangleberry. Common in the dry woodland of the southwestern lowlands. Occasional elsewhere. Fruit edible.

GAYLUSSACIA RESINOSA (Ait.) T. & G. High-bush Huckleberry. Much more abundant than the last and generally distributed in dry woodland of both lowland and knob region. The main source of edible huckleberries in the "Knob Region."

VACCINIUM STAMINEUM L. Squaw Huckleberry. Buckberry. The most abundant of the huckleberries on the Reservation. In dry soil everywhere. Fruit large, yellowish green to pale bluish when ripe, falling off the bushes about August 1st to 15th. The berries are considered inedible and are not gathered, at least in the vicinity of the Reservation.

PLATE 34.



RED FRUITED THORN
(Crataegus mollis).

LYSIMACHIA QUADRIFOLIA L. Whorled Loosestrife. Frequent in one dry open area within the Barren Oak region and also in rich moist shaded soil near certain streams. Evidently exceptional under the latter conditions.

STEIRONEMA LANCEOLATUM (Walt.) Gray. Lance-leaved Loosestrife. Common in the low moist portions of the southwestern lowlands.

CHIONANTHUS VIRGINICA L. Fringe-tree. Flowering Ash. In cultivation about Henryville and said by Mr. Raymond Freeman, to be in wild state (presumably escaped) upon the Reservation. I sought for it but failed to find any evidence of it. Its natural range does not include Indiana, and its probable occurrence upon the Reservation would not be credited except for the positive statements of Mr. Freeman.

SABBATIA ANGULARIS (L.) Pursh. Rose Pink. Very abundant in moist or dry rich soil in the lowlands of the southwestern corner. Also found sparingly, and in poorer development, upon the crest of the southern ridge.

FEASERA CAROLINENSIS Walt. American Columbo. Occasional in the drier woodland. Noticed on knob sides and in the lowlands. Said to have been abundant formerly in a certain section.

APOCYNUM CANNABINUM L. Indian Hemp. Frequent in various soils along thickets and in moist levels along streams in the open.

ASCLEPIAS TUBEROSA L. Butterfly Weed. One thrifty plant in full bloom was the only noticed representative of this species.

ASCLEPIAS SYRIACA L. Common Milkweed. Occasional in cultivated areas.

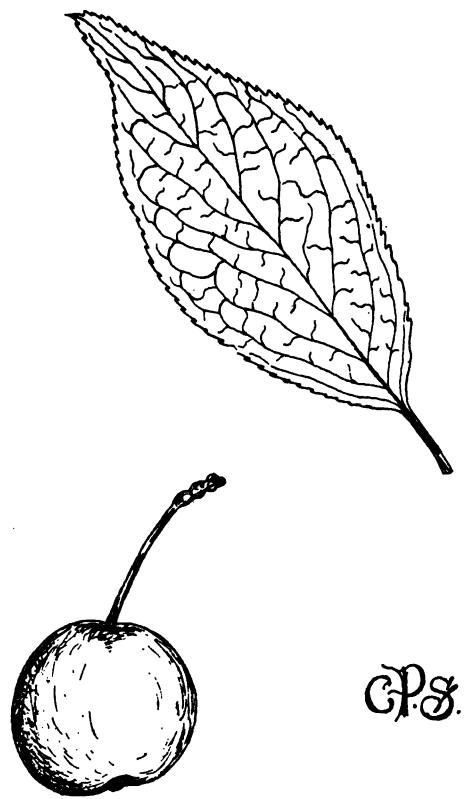
IPOMOEA PANDURATA (L.) Meyer. Wild Potato Vine. Locally known as "Wild Yam." Abundant in several sterile fields and waste levels of the lowlands. Also occasional in the mouths of the deep ravines.

IPOMOEA LACUNOSA L. Small-flowered White Morning-glory. Common in the dry waste opens of the southwestern lowlands. Not recognized elsewhere.

IPOMOEA HEDERACEA Jacq. Ivy-leaved Morning-glory. Abundant in several cornfields.

CONVOLVULUS SEPIUM L. Hedge Bindweed.

PLATE 35.



WILD RED PLUM
(*Prunus Americana*).

CONVOLVULUS ARvensis L. Small Bindweed. Both these are reported by Mr. Holton. Am surprised to know that I overlooked them. Their distribution is probably local.

CUSCUTA CEPHALANTHI Eugelm. Button-bush Dodder. Abundant in almost all moist places along all waterways upon the Reservation. At least one other dodder was noticed, but was not specifically determined.

PHLOX PANICULATA L. Garden Phlox. Common along one or two wooded streams.

PHLOX DIVARICATA L. Wild Blue Phlox. Common in woodland, possibly only in the lowlands.

POLEMONIUM REPTANS L. Greek Valerian. Noted along one stream along the eastern boundary.

HELIOTROPIUM INDICUM L. Wild Heliotrope. Reported by Mr. Holton as of very local distribution along a certain stream.

CYNOGLOSSUM VIRGINICUM L. Wild Comfrey. Common in the richer woodland, rather locally.

LAPPULA VIRGINIANA (L.) Greene. Virginia Stickseed. Very common and generally distributed in moist soil along streams, especially in rather open places in woods.

LITHOSPERMUM OFFICINALE L. Gromwell. Reported by Mr. Holton.

VERBENA URTICIFOLIA L. White Verbena. Occasional about dwellings and along roads through the opens.

VERBENA HASTATA L. Blue Wild Verbena. Less frequent than the preceding; in similar situations.

TEUCRIUM CANADENSE L. Wood Sage. Quite common along streams in the opens, and in various moist situations.

SCUTELLARIA INCANA Muhl. Downy Sculcap. Very common in moist or dry rich soil in clearings, open thickets and at the borders of woods. Mostly indicative of rich soil.

SCUTELLARIA CORDIFOLIA Muhl. Heart-leaved Sculcap. Much less common than the last. In open thickets along streams, where noted.

SCUTELLARIA PARVULA Michx. Small Sculcap. Frequent in moist soil along some wooded and thicketed streams.

PLATE 36.



WILD BLACK CHERRY
(Prunus serotina).

SCUTELLARIA CAMPESTRIS Britton. Prairie Sculcap. Common on the dry exposed knob sides. Apparently not heretofore recorded from the State.

MARRUBIUM VULGARE L. White Hoarhound. Introduced by Mr. Richard Enlow about his house. Now spreading rapidly.

NEPETA CATARIA L. Catnip. Frequent about houses, and spreading along wagon ways, etc.

PRUNELLA VULGARIS L. Heal-all. Self-heal. Very abundant. Along roadways, streams, and in moist and dry pastures, etc.

STACHYS AMBIGUA (A. Gray) Britton. Dense-flowered Hedge Nettle. Found sparingly along a certain stream through open woodland, near the center of the Reservation. Not recorded from the State, according to Dr. Coulter; but being within the range assigned to the species by Britton and Brown.

STACHYS CORDATA Riddell. Light-green Hedge Nettle. Common along streams fringed with shrubbery and occasionally in dry soil along roads. Mostly confined to the lowlands

SALVIA LYRATA L. Lyre-leaved Sage. Confined to a very limited area, namely, where a wagon-road comes out of a certain wood of the lowland, near the southern boundary. Not noticed elsewhere.

MONARDA FISTULOSA L. Horsemint. Wild Bergamot. Very common in wet or dry soil in almost all uncultivated opens.

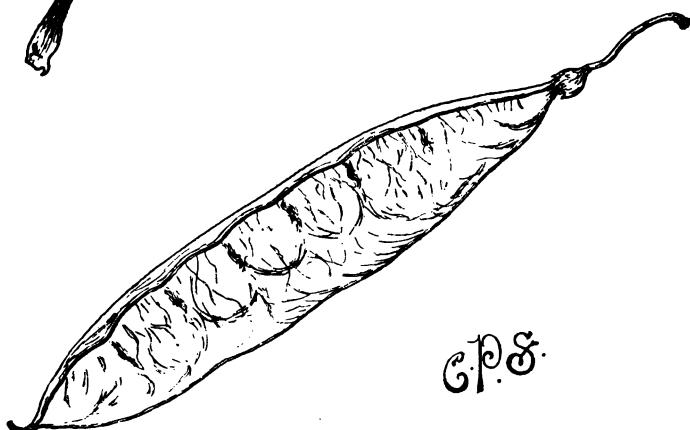
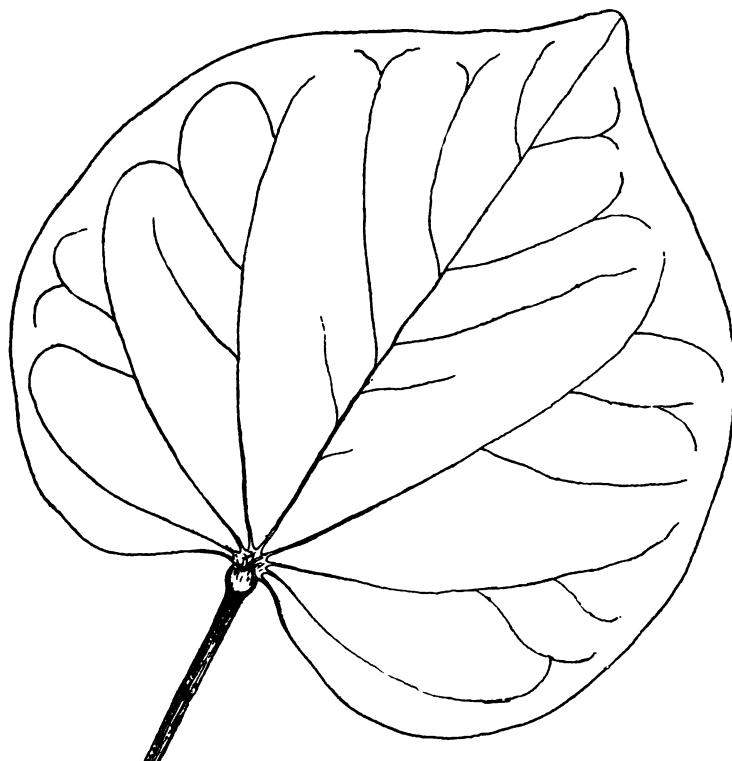
BLEPHILIA HIRSUTA (Pursh.) Torr. Hairy Blephilia. As far as observed, confined to the bottoms of the larger ravines. Not very common.

HEDEOMA PULEGIOIDES (L.) Pers. Pennyroyal. Abundant in dry soils along roads and in various neglected openings.

KOELLIA FLEXUOSA (Walt.) MacM. Narrow-leaved Mountain-mint. Very common in dry soil in various situations, principally along roads and in uncultivated clearings. Most abundant in the southwestern lowlands.

KOELLIA INCANA (L.) Kuntze. Hoary Mountain-mint. A common and characteristic plant of the open thickets and borders of woodland. Found mostly in the richer soil and of more uniform and general distribution than the preceding. This and the last species have a decided odor suggesting sage.

PLATE 37.



C.P.S.

REDBUD
(*Cercis Canadensis*).

CUNILA ORGANOIDES (L.) Britton. Sweet Horse-mint. This peculiar little shrubby mint is quite characteristic of dry poor soil in woodland. Common in the dry woods of the lowland and also in the "foot-hills" of the knobs.

LYCOPUS RUBELLUS Moench. Water Hoarhound. Taken in a dry gutter along a road. Probably to be found in greater or less abundance, locally, along streams.

MENTHA SPICATA L. Spearmint. Introduced about the Armstrong dwelling.

COLLINSONIA CANADENSIS L. Horse-balm. Frequent in rich shaded soil along streams in woodland. Distribution local.

PHYSALIS LANCEOLATA Michx. Prairie Ground Cherry. A record of Mr. Holton's.

SOLANUM NIGRUM L. Black Nightshade. Frequent in waste places near dwelling.

SOLANUM CAROLINENSE L. Horse Nettle. Very abundant in waste and cultivated fields, in pastures and along roads in open places. A thriving weed.

VERBASCUM THAPSUS L. Common Mullein. Occasional about dwellings and in neglected opens. Not common.

VERBASCUM BLATTARIA L. Moth Mullein. Of similar distribution and abundance to the preceding.

SCROPHULARIA MARYLANDICA L. Carpenter's Square. Reported by Mr. Holton. Probably not common and very local upon the Reservation.

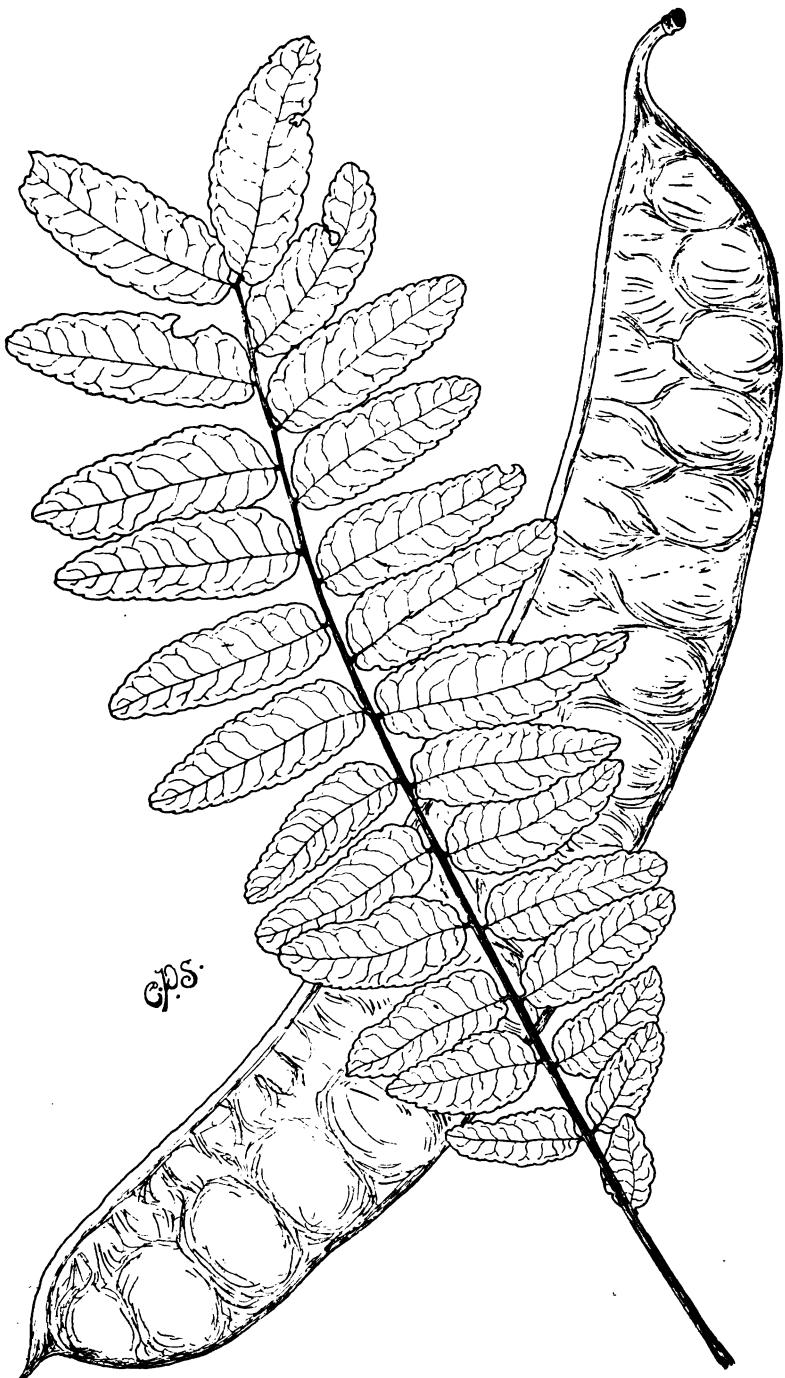
PENSTEMON HIRSUTUS (L.) Willd. Hairy Beard-tongue. Recorded by Mr. Holton.

PENSTEMON PENSTEMON (L.) Brit. Smooth Beard-tongue. Occasional along some streams.

MIMULUS EINGENS L. Square-stemmed Monkey-flower.

MIMULUS ALATUS Soland. Sharp-winged Monkey-flower. Both of these plants were noted as common in the large low moist place of the southwestern lowlands.

ILYSANTHES ATTENUATA (Muhl.) Small. Short-stalked False Pimpernel. A common little plant in the locality just cited for the two preceding species. This species also seems to have been overlooked heretofore, as regards its presence in Indiana.



HONEY LOCUST
(*Gleditsia triacanthos*).
—

DASYSYSTOMA FLAVA (L.) Wood. Downy False Foxglove. Frequent in dry soil, mostly in rather open places in woods and thickets. Well distributed in the central and eastern portions.

DASYSYSTOMA VIRGINICA (L.) Britton. Oak-leaved False Foxglove. Frequent within the range of the last, but in more shaded soils, generally.

GERARDIA TENUIFOLIA Vahl. Slender Gerardia. Of irregular distribution and soil condition. Found in the dry sterile soil of the Barren Oak region and on the edges of moist low levels in the opens.

PEDICULARIS CANADENSIS L. Common Louse-wort. Occasional in dry soil of thickets along the eastern boundary.

LEPTAMNIUM VIRGINIANUM (L.) Raf. Beech-drops. Parasitic upon the roots of the beech, and therefore found only where that tree occurs. Confined to shaded and moist situations, where dead leaves are abundant.

TECOMA RADICANS (L.) DC. Trumpet-creeper. Occasional in the dry woods and thickets of the southern limits and more abundant in the greater and lesser ravines of the northern portions, there often in rich soil.

RUELLIA CILIOSA Pursh. Hairy Ruellia. Occasional in the drier woods, especially along wagon paths in rather open places.

PHRYMA LEPTOSTACHYA L. Lopseed. Two specimens noted, widely separated. In comparatively dry, shady woodland. Reported as rare by Mr. Holton also.

PLANTAGO MAJOR L. Common Plantain.

PLANTAGO RUGELII Decaisne. Rugel's Plantain. Both these forms were recognized about dwellings. Spreading slowly along wagon paths.

PLANTAGO LANCEOLATA L. English Plantain. Common about dwellings, especially upon the Hollister knob.

PLANTAGO ARISTATA Michx. Large-bracted Plantain. Superabundant upon the Hollister knob, covering large areas to the exclusion of all other plants of similar size and habit.

HOUSTONIA PURPUREA L. Large Houstonia. Frequent in dry soil of the southwestern lowlands, along roads and in waste open places.

PLATE 39.



C.P.S.

RED MAPLE
(Acer rubrum).

Leaf three-fourths natural size.

HOUSTONIA CILIOLATA Torr. Fringed Houstonia. Only one clump of plants of this species was noted. This was in dry soil, at the edge of a cornfield.

CEPHALANTHUS OCCIDENTALIS L. Button Bush. Very common in the low moist places and along most streams, in woods or open.

DIODIA TERES Walt. Rough Button-weed. Noted only in a very limited range, namely in the dry gutter along the public road through the southwestern lowlands.

GALIUM CIRCAEZANS Michx. Wild Liquorice. Common in the richer woods, especially in moist soil along streams.

GALIUM TRIFLORUM Michx. Sweet-scented Bedstraw. Common in woodland, under various soil conditions, as is also

GALIUM CONCINNUM T. and G. Shining Bedstraw.

SAMBUCUS CANADENSIS L. Elderberry. Quite frequent along streams and in moist soil generally, but not regularly distributed.

VIBURNUM ACERIFOLIUM L. Maple-leaved Viburnum. Common in the richer woodland, especially on the densely shaded knob sides, sloping down into the ravines.

VIBURNUM MOLLE Michx. Soft-leaved Arrow-wood. Noted amidst dense shrubbery at the edge of a certain wood near the southeastern corner. Not met with elsewhere.

VIBURNUM PRUNIFOLIUM L. Black Haw. Occasional along streams.

TRIOSTEUM PERFOLIATUM L. Horse Gentian. Reported by Mr. Holton.

TRIOSTEUM ANGUSTIFOLIUM L. Narrow-leaved Horse Gentian. I found one plant of this species and looked out for others, but saw no more. Perhaps both this and the last could have been found more or less frequently, in the richer woodland, earlier in the season.

CAMPANULA AMERICANA L. Tall Bellflower. Abundant in rich shaded soil along streams.

LEGOUZIA PERFOLIATA (L.) Britton. Venus's Looking Glass. Common in dry sterile soil on exposed knob sides and in the clearing on top of the Hollister Knob. Mainly indicative of poor soil.

PLATE 40.



SUGAR MAPLE
(Acer Saccharum).

Leaf three-fourths natural size.

LOBELIA CARDINALIS L. Cardinal Flower. In moist soil along streams. Comparatively rare.

LOBELIA SYPHILITICA L. Great Blue Lobelia. Rather common along streams, especially in the deeper ravines.

LOBELIA INFLATA L. Indian Tobacco. Very common in open places, either in dry fields or along streams. Especially common in the small clearings at the foot of the Hollister Knob.

SONCHUS ASPER (L.) All. Spiny Sow-thistle. Occasional in waste places about houses.

LACTUCA SCARIOLA L. Prickly Lettuce. Frequent in waste places.

LACTUCA CANADENSIS L. Wild Lettuce.

LACTUCA SAGITTIFOLIA Ell. Arrow-leaved Lettuce. Both of these forms are common to abundant in neglected and waste opens, along roads, etc., the former especially invading corn-fields and the edges of woods and thickets.

LACTUCA VILLOSA Jacq. Hairy-veined Blue Lettuce. Common in shady moist places along streams and at the borders of richer woods and thickets.

HIERACIUM GRONOVII L. Hairy Hawkweed. Frequent in the drier woodland of both lowland and knob region.

AMBROSIA TRIFIDA L. Great Ragweed. Horse-weed. Abundant along streams and borders of woodland and thickets.

AMBROSIA ARTEMISIAEFOLIA L. Common Ragweed. Frequent in waste places, but especially in grain stubble fields.

XANTHIUM STRUMARIUM L. Cockle-bur. Abundant in cornfields and neglected places; also in moist soil along some streams in the open.

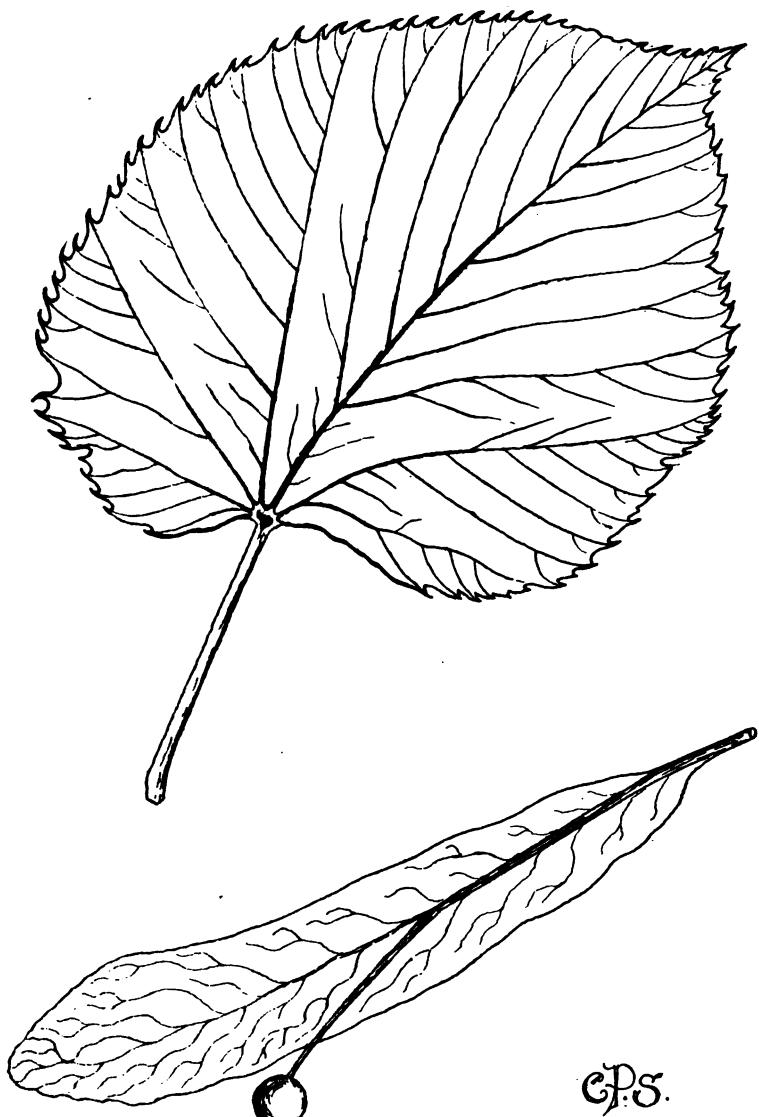
VERNONIA FASICULATA Michx. Western Ironweed. Very common along streams and in almost all open places and along borders of woodland.

EUPATORIUM PURPUREUM L. Joe-Pye Weed. "Queen-of-the-Prairie." Common in open thickets and along borders of woods and streams.

EUPATORIUM SESSILIFOLIUM L. Upland Boneset. Common in the richer woods, preferring shade.

EUPATORIUM PERfoliatum L. Common Boneset. Also along streams and borders of woods and thickets.

PLATE 41.



LINN
(*Tilia Americana*).
—

- EUPATORIUM AGERATOIDES** L. f. White Snakeroot. Frequent in moist shaded soil along streams.
- EUPATORIUM COELESTINUM** L. Mist Flower. Found occasionally along roads. Not common.
- LACINARIA SQUARROSA** (L.) Hill. Scaley Blazing Star. Colic-root. Frequent in dry soil along the crests of the knob-ridges. Heretofore reported from Gibson and Posey counties only.
- LACINARIA SPICATA** (L.) Kuntze. Common along shaded streams and wagon-paths in the woodland of the eastern lowlands.
- SOLIDAGO FLEXICAULIS** L. Broad-leaved Golden-rod. Common at borders of woodland.
- SOLIDAGO JUNCEA** Ait. Sharp-toothed Golden-rod. Abundant in dry uncultivated opens.
- SOLIDAGO NEMORALIS** Ait. Field Golden-rod. Common. Associated with the last.
- EUTHAMIA GRAMINIFOLIA** (L.) Nutt. Bushy Golden-rod. In moist places along streams. Frequent.
- ASTER PATENS** Ait. Late Purple Aster. In dry open woods or fields, common, irregularly distributed. First noted in bloom on August 14th.
- ASTER DUMOSUS** L. Bushy Aster. Frequent in neglected fields.
- ASTER MULTIFLORUS** Ait. Dense-flowered Aster. Abundant in waste and cultivated opens, especially along the borders.
- ERIGERON ANNUUS** (L.) Pers. White Top. Fleabane.
- ERIGERON RAMOSUS** (Walt.) B. S. P. Slender White Top. Both these forms are common in neglected fields and about houses.
- GNAPHALIUM OBTUSIFOLIUM** L. Common Everlasting. Very common in the dry fields of the southwestern lowlands.
- SILPHIUM TRIFOLIATUM** L. Whorled Rosin-weed. Noted only along the stream near the extreme southeastern corner. Probably elsewhere in similar environments.
- HELIOPSIS HELIANTHOIDES** (L.) B. S. P. False Sunflower. In dry open woods, both in the lowlands and on knob sides.
- ECLIPTA ALBA** (L.) Hassk. Eclipta reported by Mr. Holton. Found in the moist low ground near the southwestern corner and probably in similar situations elsewhere.
- RUDBECKIA HIRTA** L. Black-eyed Susan. Abundant in all dry soils of the opens, regardless of elevation.



FLOWERING DOGWOOD
(Cornus florida).

HELIANTHUS MICROCEPHALUS T. and G. Small Wood Sunflower.

Common on the wooded knob sides, especially eastwardly.

HELIANTHUS DIVARICATUS L. Rough Woodland Sunflower.

Abundant in almost all woodlands and thickets, except for being less common in the barrens of the lowlands.

HELIANTHUS HIRSUTUS Raf. Stiff-haired Sunflower. Abundant in the range occupied by *H. microcephalus*, as noted above.

VERBESINA HELIANTHOIDES Michx. Abundant in a bushy opening east of the center and frequent elsewhere in dry soil in thickets or along edges of woodland.

VERBESINA ALTERNIFOLIA (L.) Britton. Very common and more generally distributed than the preceding. Found in similar environments.

COREOPSIS TRIPTERIS L. Tall Tickseed. Frequent in somewhat shaded situations along certain streams.

BIDENS CONNATA Muhl. Purple-stemmed Swamp Beggar-ticks. Common in low wet places.

BIDENS FRONDOSA L. Common Beggar-ticks. Very common in wet and dry situations, along streams and in waste places.

BIDENS BIPINNATA L. Spanish Needles. Noted as occasional along the road approaching the Hollister Knob.

HELENIUM AUTUMNALE L. Sneezeweed. In moist soil along streams, in clearings or open woodland. Not very common.

ACHILLEA MILLEFOLIUM L. Yarrow. On the Hollister Knob and along roads, sparingly.

ANTHEMIS COTULA L. Common Dog Fennel. In waste places about houses. Not very common.

CHRYSANTHEMUM LEUCANTHEMUM L. Ox-eye Daisy. Common on the Hollister Knob clearing. Not noted elsewhere.

TANACETUM VULGARE L. Tansy. A thriving clump exists along the road in front of the Armstrong house.

ERECTITES HIERACIFOLIA (L.) Raf. Fire-weed. Abundant in clearings and open woods, especially westwardly, and regardless of elevation.

MESADENIA ATRIPLICIFOLIA (L.) Raf. Pale Indian Plantain. In moist places at the borders of lowland woods and in the deeper ravines. Not very common.

PLATE 43.



TUPELO OR BLACK GUM
(*Nyssa sylvatica*).

ARCTIUM LAPPA L. Burdock. Occasional in waste places near dwellings.

CARDUUS ALTISSIMUS L. Tall Thistle. Abundant along streams and at edges of thickets.

CARDUUS DISCOLOR (Muhl.) Nutt. Field Thistle. Common in waste places, mostly about or near dwellings.

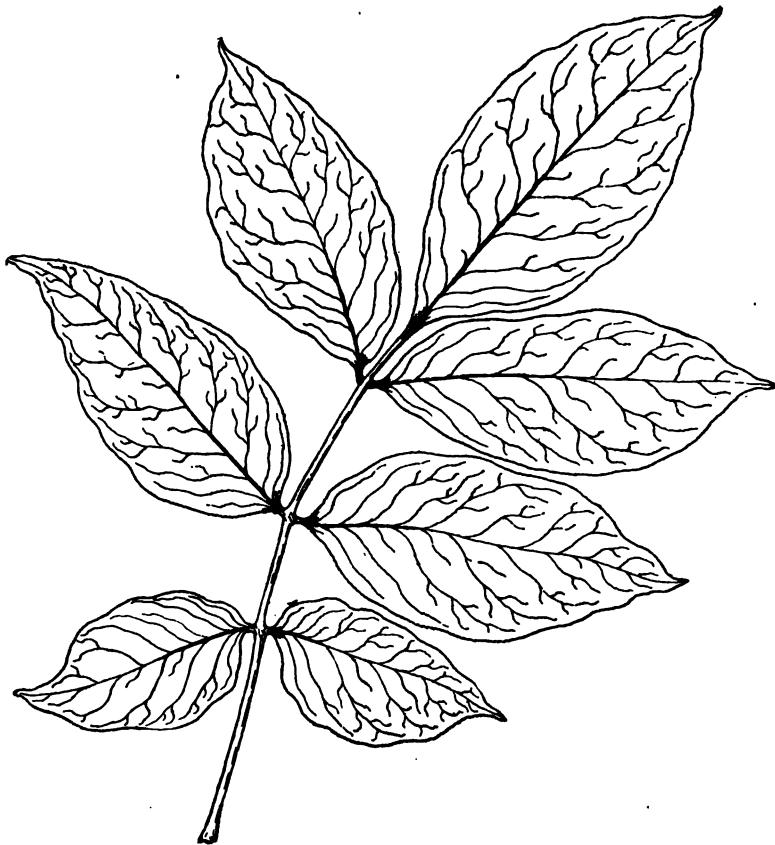
PLATE 44.



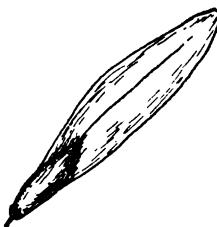
AFS.

PERSIMMON
(*Diospyros Virginiana*).

PLATE 45.

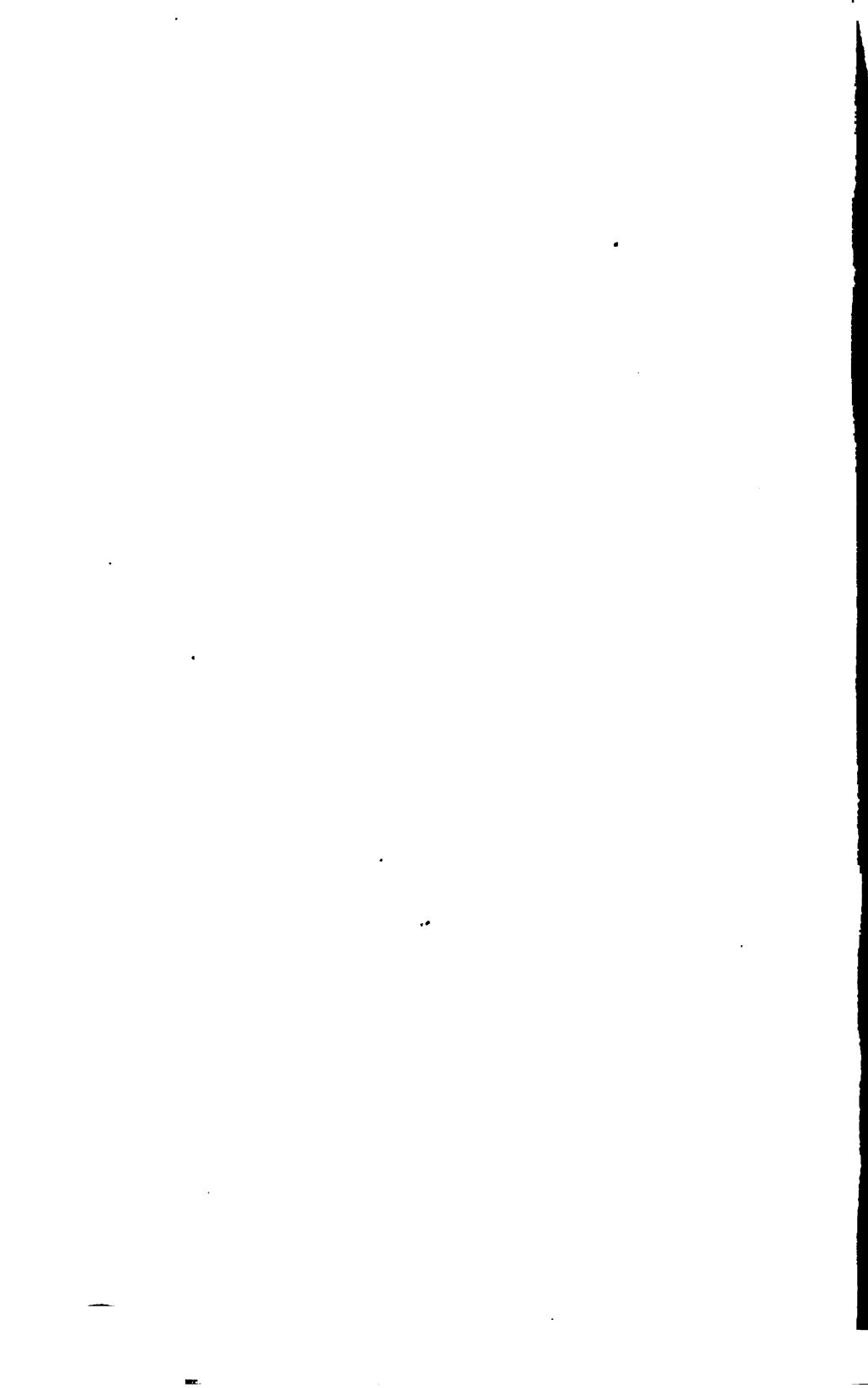


C.P.S.



WHITE ASH
(Fraxinus Americana).

Fruit full size; leaf three-eighths natural size.



KEY

- RESERVATION BOUNDARY - - - - -
WATER COURSES ~~~~~
ROADS AND WAGON PATHS - - - - -
KNOB SIDES ~~~~~ 
CLEARED PORTIONS 
AREAS MUCH THINNED BY FIRE
|||||
AREAS STRIPPED BY FIRE
|||||
PINE AREAS

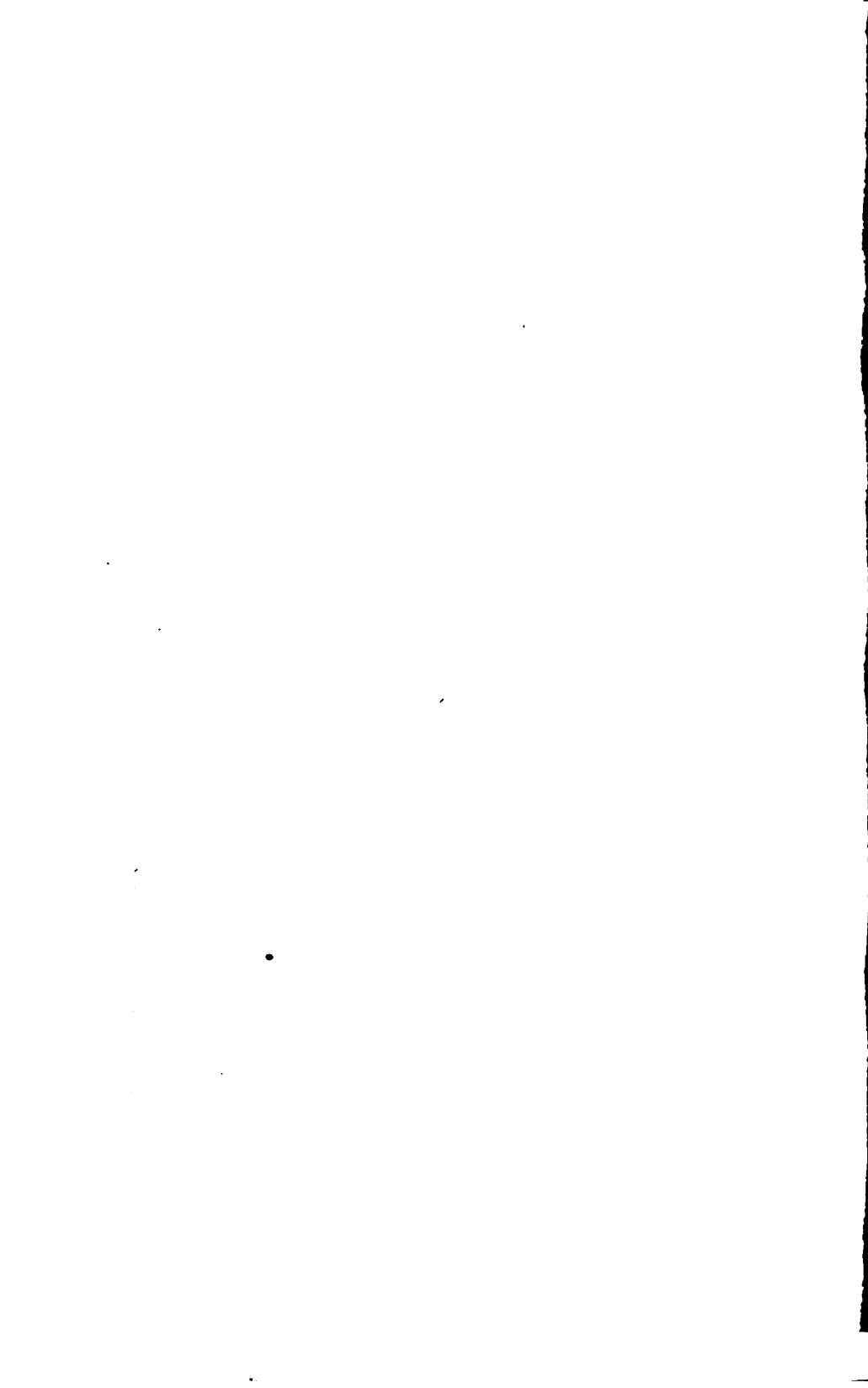

WHERE THE CHESTNUT
IS PROMINENT

AREAS OF WHITE-S
OAK PREDOMINANT
(WITH POST OAK //)

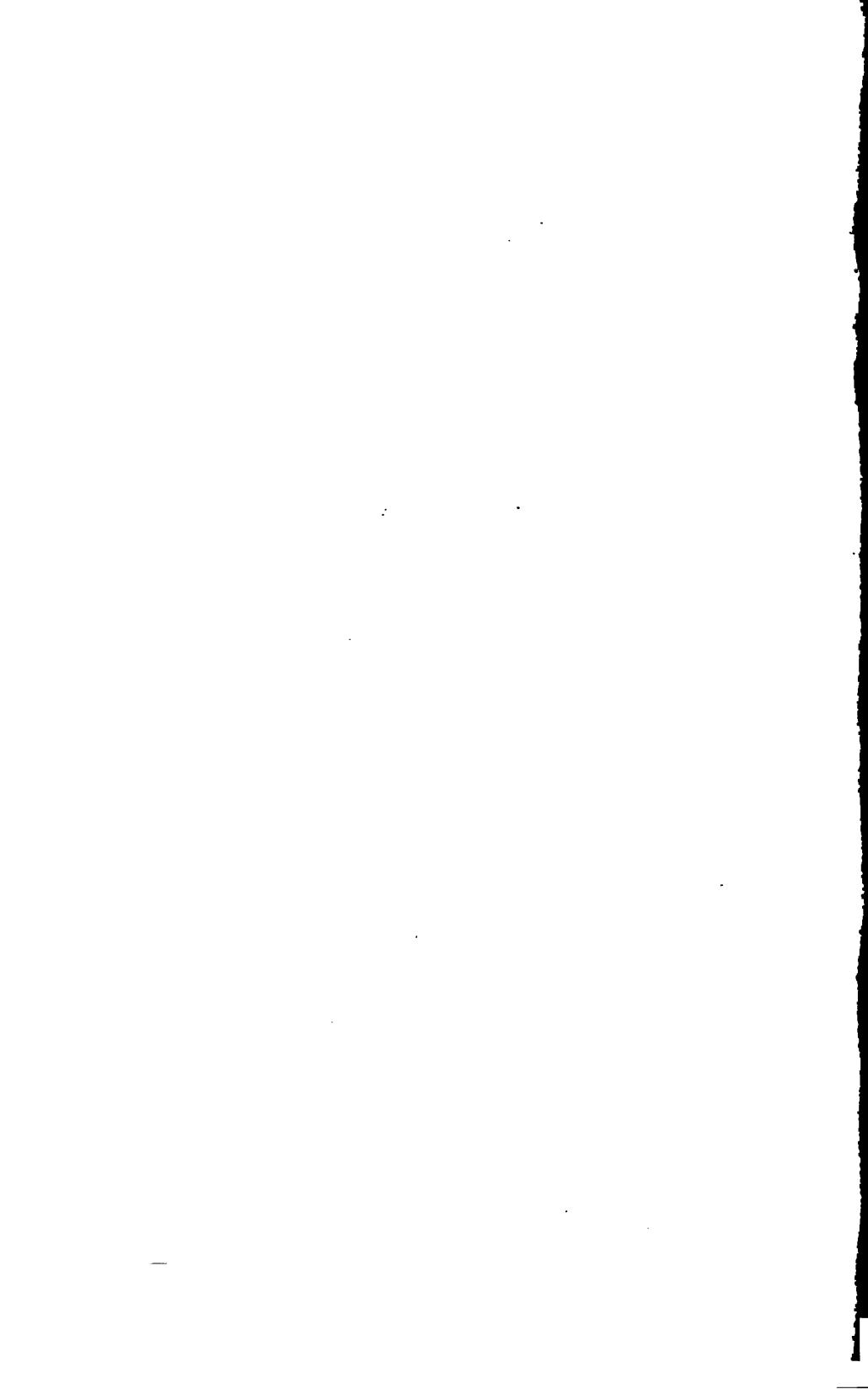
BARREN OAK AREAS
ANY OTHER CONDITION

DRAWN BY
G.P. Smith Jr.









Feb 15/5/3
V. (372)
(Boyle et al.)

STATE OF INDIANA



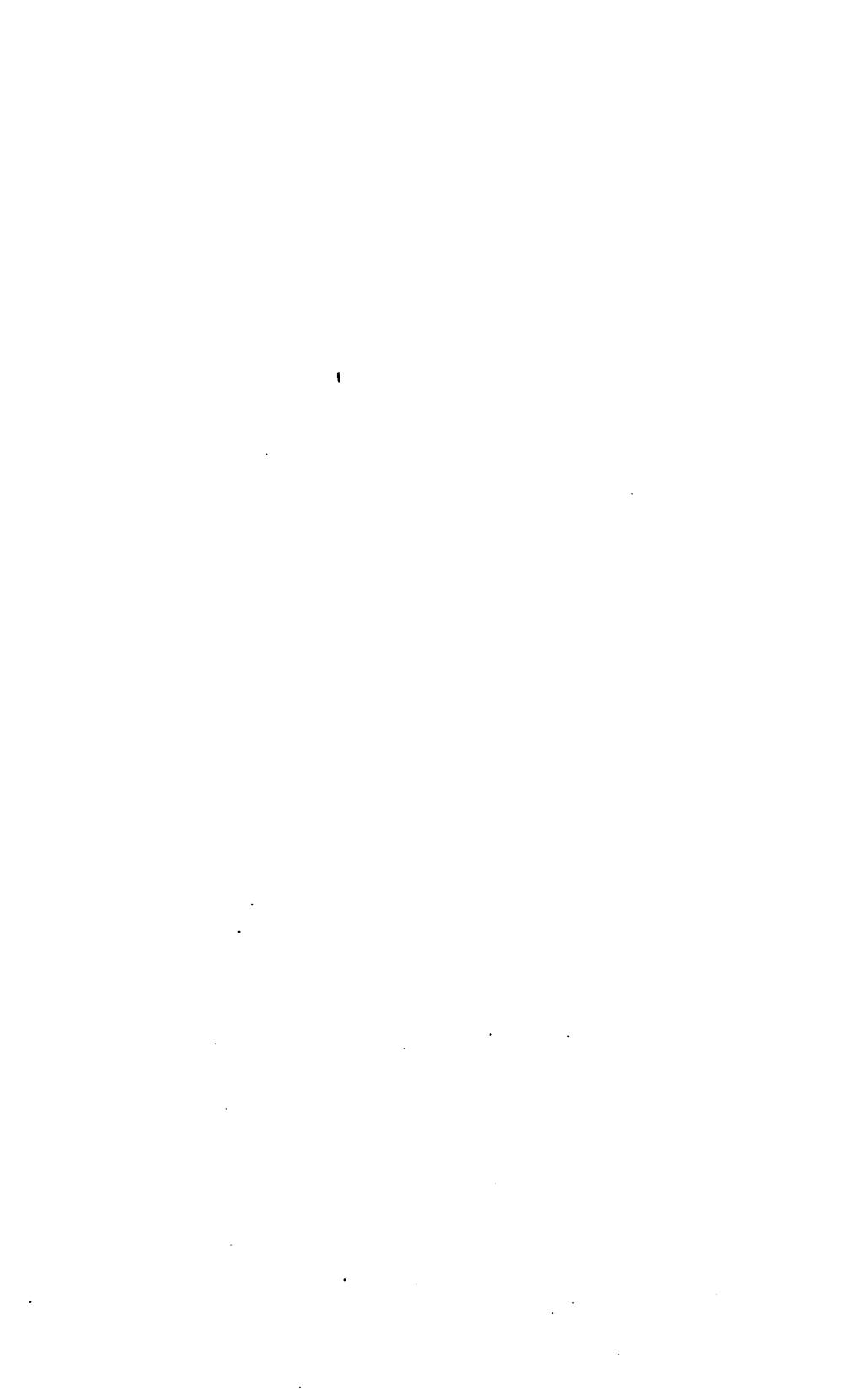
Fourth Annual Report of the

**State Board of
Forestry**

1904

**W. P. Freeman
Secretary**

TO THE GOVERNOR OF INDIANA







An institution which is rapidly passing out of existence in Indiana, but which in its day has consumed enough
valuable oak, walnut, poplar, hickory, ash and other valuable timbers to purchase the
larger part of the land in Indiana if now standing and at the present
prices for prime trees such as were then used.

STATE OF INDIANA

FOURTH ANNUAL REPORT

OF THE

STATE BOARD OF FORESTRY

1904

W. H. Freeman, Secretary

TO THE GOVERNOR OF INDIANA
WINFIELD T. DURBIN

INDIANAPOLIS:
WM. B. BURFORD, PRINTER AND BINDER.
1902.

THE STATE OF INDIANA,
EXECUTIVE DEPARTMENT,
December 13, 1904. }

Received by the Governor, examined and referred to the Auditor of State
for verification of the financial statement.

OFFICE OF AUDITOR OF STATE,
INDIANAPOLIS, December 13, 1904. }

The within report, so far as the same relates to moneys drawn from the State
Treasury, has been examined and found correct.

D. E. SHERRICK,
Auditor of State.

DECEMBER 13, 1904.

Returned by the Auditor of State, with above certificate, and transmitted to
Secretary of State for publication, upon the order of the Board of Commissioners
of Public Printing and Binding.

GEORGE B. LOCKWOOD,
Private Secretary.

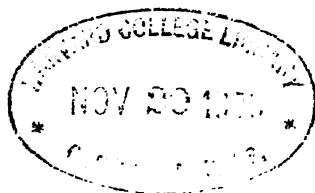
Filed in the office of the Secretary of State of the State of Indiana, Decem-
ber 14, 1904.

DANIEL E. STORMS,
Secretary of State.

Received the within report and delivered to the printer December 14, 1904.

THOS. J. CARTER,
Clerk Printing Bureau.

V. 6272



Indiana State Forestry

INDIANA STATE BOARD OF FORESTRY

OFFICIAL MEMBERS, 1904

FINLEY C. CARSON, President.....	Michigan City
STANLEY COULTER.....	LaFayette
ALBERT LIEBER.....	Indianapolis
JOHN COCHRANE.....	Indianapolis
Wm. H. FREEMAN, Secretary.....	Wabash
Mrs. ELLA GROW, Stenographer.....	Indianapolis

Office of Secretary

Room 93, State House, Indianapolis.

STATE OF INDIANA, BOARD OF FORESTRY,
Indianapolis, Ind., December 1, 1904.

Hon. Winfield T. Durbin, Governor:

Dear Sir—In accordance with the law by which the State Board of Forestry was organized, we have the honor to submit herewith the manuscript of the Fourth Annual Report of the work accomplished the past year, discourses for forest cultivation and recommendations for legislation to better promote the institution of forestry within the State as in the judgment of the Board seems expedient.

Yours respectfully,

F. C. CARSON, President.

W. H. FREEMAN, Secretary.

FINANCIAL STATEMENT

November 1, 1903, to October 31, 1904

ANNUAL APPROPRIATION BY ACTS OF GENERAL ASSEMBLY, 1903.

Office:

Salary of Secretary.....	\$1,800 00
Salary of Stenographer.....	600 00
Salaries of four Board members, each \$100.....	400 00
Mileage of four Board members	67 56
General expenses of office.....	1,000 00
<hr/>	
Total	\$3,867 56

Forest Reservation and Experiment Station:

Expenses of management and labor of.....	\$3,000 00
--	------------

EXPENDITURES.

Office—salaries and mileage:

Salary of Secretary, W. H. Freeman.....	\$1,800 00
Salary of Stenographer, Ella Grow.....	600 00
Salary of Board member, F. C. Carson.....	100 00
Salary of Board member, Stanley Coulter	100 00
Salary of Board member, Albert Lieber	100 00
Salary of Board member, John Cochrane	100 00
Mileage of Board members.....	67 56
<hr/>	
Total	\$2,867 56

Office—General expenses:

Field work (reports and maps) for use in office.....	\$438 50
Office fixtures, telephone and incidentals.....	209 43
Photography and photographic supplies.....	37 27
Mileage and livery.....	67 00
Postage	150 00
Printing and stationery.....	97 32
<hr/>	
Total	\$999 52
Balance	48

Forest Reservation and Experimental Station:

General management expenses and supplies.....	\$1,171 10
Labor	1,777 55
Seeds	51 35
<hr/>	
Total	\$3,000 00



A view showing a type of forest remaining in Indiana at the present time.

PREFACE

The work accomplished by the Indiana State Board of Forestry the year just past is more extensive and far-reaching than can be definitely stated in this report. A goodly amount of information has been ascertained and given out from time to time through correspondence and newspaper articles. A vigorous crusade of agitation of the subject has been carried on almost constantly in all parts of the State, and the importance of forestry advancement and forest protection is uppermost in the minds of the people in every locality. There has been formed a strong sentiment of appreciation for the cause, which will sooner or later ripen into sincere and concerted activities. Men and women possessing notable recognition for thought and intellect are observing and studying the problem and the conditions and are formulating plans and shaping advice as to the best course to pursue in the prosecution of forest enterprises within the State.

A great number of addresses on the subject of forestry were made at both private and public gatherings of various kinds. At Farmers' Institutes, educational assemblages, club organizations, associations of horticulture and agriculture and conventions, topics of forestry were given prominent places on the programs and in the discussions. These elements are the most hopeful indications for the success of the cause, and they reveal the mind of the people. Although the difficulty of finding a timber supply for the uses of the manufacturing industries affords a great temptation, because of the good price offered for forest owners to dispose of their timber product, there is vastly less of the sentiment and disposition to minimize the woodlands. There is forming strongly and surely a disposition to carefully guard the present forests and a maximum tendency to dedicate and reforest the cheaper broken lands. The thoughts are becoming rapidly adjusted to the dangerous condition into which the country was drifting, and in every community are found men who are thoroughly awakened to the

necessity for immediate activity and because of their wider vision and greater forethought they are sounding a warning note against the ruthless forest destruction.

When the far-reaching results of the past neglect in handling forests is seen the first thought, perhaps, is to remedy the evil to the extent of preventing future recklessness by legislation. The thought would be to legislate men into doing that which their own intelligence should know is the right thing for them to do. The Board has found it necessary in the past to seek some legislation in order to have a fitting foundation for it to become an effective body, and it sees wherein other legislation will be beneficial in the future and the same will be discussed in this report. It is not, however, in any sense the idea that right forestry can be legislated into existence. It is activity and not law which will solve the forestry problem, but legislation can be enacted which will induce activity, and that shall be the aim sought by the Board in all legislative attempts. The greatest efforts, therefore, by the Board have been directed to the stimulating and the awakening of the minds of the people to the conditions of the necessity for and the best methods and plans to follow. It feels that these elements, rightly instituted with the people, are more important than laws. The members of the General Assembly are keenly alive to the best and highest interests of the people and the State, and when the suggestion is made that the forest problem is one of the most important problems to solve in connection with the welfare and progress of us all they will investigate the matter, use their best judgment and enact just and suitable laws.

The discourses herein submitted, as well as the illustrations, are aimed to suggest and guide those who may wish to engage in forestry work upon their own lands. The constant aim in all directions of means and methods are simplicity and practicability.

The Board unqualifiedly acknowledges its obligations to the public-spirited citizens of Indiana in the ways before stated for the successful forestry achievements to the present time. In particular is the Board under obligations to the public press, the retiring Governor, Winfield T. Durbin, and his associate members of the State Printing Board. The press has been more than liberal with its columns, and the Governor, with his associates, have been

very liberal, yet conscientious and business demanding in their support of this worthy movement.

In conclusion, the Board urges an increased activity and interest in forestry by the entire people. It urges, however, that more attention be given to stable forest plantings of the commercial hardwoods, such as the industries will demand in the future. Investigate the cheap land sections of the State and establish forestry estates. Surely in this there are great opportunities.

REPORT OF EXPERIMENTS, IMPROVEMENTS, CONDITIONS AND REQUIREMENTS

**AT THE FOREST RESERVATION AND EXPERIMENTAL STATION AT HENRYVILLE, CLARK COUNTY, IND.,
TO DECEMBER 1, 1904.**

SEEDS—TREATMENT AND PLANTING.

The walnut, hickory, oak and black locust seeds which were stored by stratifying them in sand in the fall of 1903 were taken from storage and planted at different periods of time in range from May 6th to 30th this last spring, 1904. The ash, lin, catalpa and pine seeds, which were secured at the same time and stored in a dry, cool room, were also planted during the same period of time.

The extent and the result of these experiments must be considered from the view that the season of 1903 was a very poor one for securing either a good quantity or a good quality of seeds, as stated in last year's report.

The storage experiment was a success in every way so far as seed effects were concerned. Large box beds were built upon the surface of the ground in the open and upon a well-drained site. In these were placed alternately layers of seeds and sand until they were filled. Sand enough was placed over the lower layers of seeds to imbed them completely and to afford a solid encasement for holding the moisture. Over the last layer, at the top was placed a covering of from three to four inches of sand to prevent the upper layers from drying out and thus hinder the killing of the germ by the alternate moistening and drying of the seeds, as would result by reason of the alternate changes in the climate. No straw or other mulch was placed over them, as it adds to the enticement of rodents, which are always to be guarded against in seed storage. The seeds were permitted to receive all the weathering from December to the time of removal for planting, approximately five months.

When the seeds were removed from the storage the results were very decided. All the poor seeds were rotted or the defects so developed that there was no difficulty in detecting them. The good seeds were in a splendid condition and in the full vigor of germination. By placing the seeds when removed into vessels of water complete separation of the good and bad seeds was accomplished. The former at once sank and the latter floated and were cast away.

The approximate amounts of bad seeds as determined by this treatment were as follows: Walnut, 10 per cent.; hickory, 20 per cent.; oak, 60 per cent.; chestnut, 50 per cent., and locust 0 per cent.

A condition arose in this feature of the work which was unlooked for and which will be given to guide others from a like occurrence. The season of last spring was decidedly rainy and thus prevented the preparation of the ground for planting as early as should have been to receive the seeds before they attained a too advanced state of germination, as forest seeds germinate very early if moisture and light is afforded them. As a consequence many seeds were lost in removing them from storage by their falling apart or the destroying of the sprouts, as many when removed were far advanced both in root and stem. As soon as the conditions of the seeds and the climatic probabilities were appreciated every effort was made to push the land preparation and retard the seed germination. The storage beds were covered with boards to shut out the light. Had the climatic conditions been foreseen and this precaution taken early the advanced germination could have been overcome to a large extent.

Another thing occurred which prevented the extent of both storage and planting. Eight bushels of acorns secured in Tennessee from a seed firm, were not properly cured before shipment, and after being placed in bulk for shipment, and because of delay en route, became heated and sprouted until worthless when they arrived and were rejected, and thus limited the quantity of acorns for storage to but two bushels which after the tests left but a small quantity for the planting.

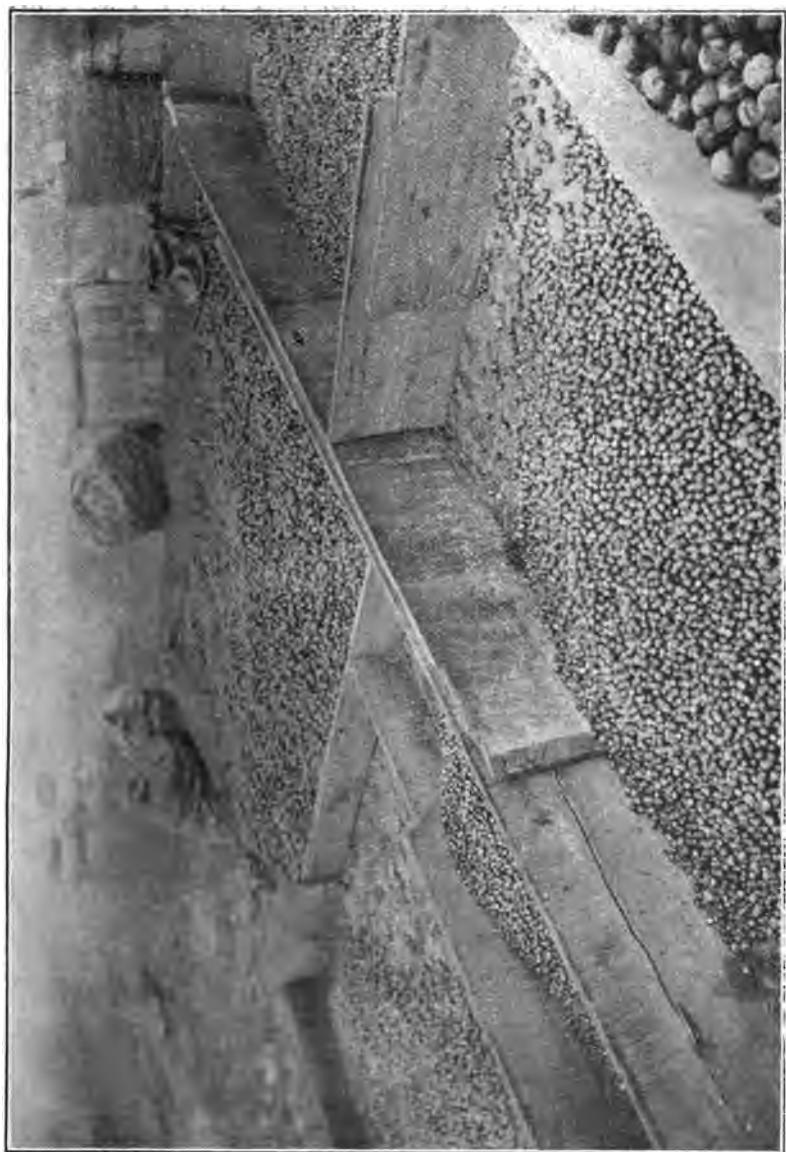
The planting of the seeds was performed in the most simple and speedy manner. The abandoned, worn-out fields were prepared in the same manner as for corn planting, except the ground was

not thoroughly pulverized and was crossed off at greater distances. When the ground was well plowed or disked, as was done, a marker was made of heavy oak plank and steel to perform the work of checking the rows. It was made in the form of a sled with the runners plated with steel drawn to a cutting edge in front and widened to a distance of four inches at the back. By this device and a good team the ground was well and speedily prepared. The planting was at distances of five feet apart each way. Men with apron sacks filled with seeds and suspended in front of them from their shoulders dropped the seeds into the checks and with ordinary farm hoes covered them. The seeds were brought from storage directly to them and at no time were they permitted to become dry before they were planted. The kinds of seeds planted on a field or a part of it were determined by the soil character. Adaptation of soil and seed were observed, though as an experiment, to fully determine that a tree will not do any good or only fairly good on a certain soil, and a given condition was thought to be worth almost if not as much as to know the affirmative result, and thus departures were made from the observance.

The plantings were both pure and mixed, as shown by the following descriptions:

1. Eight acres black walnut, planted on porous, sandy, clay soil of 700 feet average elevation.
2. Four acres walnut and chestnut in groups of rows each, planted on porous, sandy, clay soil of 630 feet average elevation.
3. Seven acres shellbark hickory, planted on hard, sandstone, clay soil of 600 feet average elevation.
4. Seven acres shellbark hickory and chestnut planted on sandstone, porous, clay soil of 620 feet average elevation.
5. Five acres shellbark hickory and white oak planted on hard, sandstone, clay soil of 600 feet average elevation.

The first of these plantings is far more successful, to the present, than any of the others. A splendid rain fell soon after it was done, and within ten days thereafter the young walnuts were shooting through the ground in almost a perfect stand. Two seeds were planted in a hill and were placed about two inches apart. This number was planted in a hill to insure a perfect stand on the planted area, with the idea that if they came well thinning could be done and the young seedlings transplanted to the vacant spaces



A view showing a section of the seed yard at the Forest Reservation and Experimental Station.

and other fields to determine the success of transplanting walnut seedlings.

The seeds came and grew almost perfectly, and the work of digging and transplanting the excess seedlings will be done the coming spring of 1905. The only notable loss from a perfect stand is due to the squirrels, which dug the seeds up and carried them away on the parts of the fields next to the timbered areas.

At this same time, and under the same conditions and by the same methods, were planted two acres of dry, unstored walnuts. Up to date there are no signs of growth from these seeds. The inference is that they will put forth next year. This instance affords splendid argument for the storage of walnuts before planting.

The other plantings did not do so well. The oaks and the chestnut were more advanced in germination than the hickory and walnut, and hence were more liable to injury from the removal and planting. For almost ten weeks after planting the last fields no rain at all fell, and none of any decided consequence came till the last of September from the time of the planting. It is a matter of record that such a drouth has not been known in that vicinity for more than fifty years, though drouth is common to the locality. Because, then, of these conditions over which man has no control, many of the seeds perished before any perceptible growth or soon thereafter. The walnuts and hickory nuts were more hardy against such conditions, and since the rains of the late summer and autumn are coming through the ground in splendid numbers. Of the plantings the following per cents. may be given as fairly accurate for the stand of seedlings obtained: Walnut, 90 per cent.; hickory, 75 per cent.; chestnut, 30 per cent., and oak, 20 per cent. All conditions considered, the results are good and afford good hopes for excellent results under more fair conditions.

The growth of the seedlings has suffered from the same causes of drouth as above given. Except the walnut the seedlings are in all stages, from just coming through the ground to eighteen or twenty inches high. The only cultivation which was given them was with the harrow. The ground was left unpulverized at the time of planting. During the summer a weighted harrow was dragged over the ground, straddling the rows, and by this method sufficient cultivation was given to keep down the weeds.

The ash, lin, catalpa, locust and pine seeds which were sown in the nursery made no progress. They simply burned in the ground, so that the nursery effort may be classed as a failure. No irrigation means were at hand to facilitate this feature, and the effort will be renewed this fall.

Ash seeds were sown broadcast along the streams also during the last spring, but no results are visible at this time. It may be that later results will develop.



A view showing the method of seed planting on the fields at the Forest Reservation.

With the above conditions and results in mind the Board has decided to plant the seeds this fall, 1904, instead of storing them in sand and again risking the climatic conditions of another spring season. Owing to the excessive drouth of the past summer good seeds are not available in the locality, and from the same and other reasons good seed can not be found in any part of the State

or the adjoining States. Enough good seeds, however, by great effort have been obtained to perform the following plantings:

1. Thirteen acres mixed oaks, shellbark hickory, chestnut, walnut, ash, cherry and lin, planted in sandy, porous, clay soil of 520 feet average elevation.
2. Eighteen acres walnut, mixed oaks, shellbark hickory, chestnut and cherry, planted in sandy, porous, clay soil of 560 feet average elevation.
3. Twenty-five acres shellbark hickory, cherry, mixed oaks, chestnut and ash, planted in hard, sandstone, clay soil of 620 feet average elevation.
4. Fifteen acres shellbark hickory, mixed oaks, ash and walnut, planted on sandy, porous, clay soil of 580 feet average elevation.
5. Fifteen acres mixed oaks, cherry and shellbark hickory, planted on hard, sandstone, clay soil of 590 feet average elevation.
6. Fifteen acres of nursery of every kind of seed included in the above plantings, and locust, poplar, sycamore, pine, mulberry and catalpa in addition.

All seeds planted on the above areas were tested in water to avoid planting defective ones. The test showed the following approximated per cents of bad seeds: Acorns, 40 per cent.; hickory, 20 per cent.; chestnuts, 20 per cent.; lin, 60 per cent.; cherry, 5 per cent.; walnut, 5 per cent.; ash, 20 per cent.; mulberry, 2 per cent.; coffeenut, 0 per cent.; pecans, 5 per cent., and pine, 3 per cent.

The extent of seeds secured to date is as follows: Forty-eight bushels of mixed acorns, 2 bushels of lin, 2 bushels of cherry, 15 bushels of shellbark hickory nuts, 8 bushels of chestnuts, 200 pounds of ash, 100 pounds of locust, 2 pounds of mulberry, 50 pounds of Kentucky coffee tree, 10 pounds of Texas pecans and 5 pounds of white pine. Nearly all of this quantity was secured outside of Indiana.

The field plantings were at distances of five feet apart each way, with the two exceptions, and the different species of seeds were planted in alternated rows or groups of rows. The nursery was planted by drilling the seeds thickly in rows at three feet apart. In all the work the ground was prepared in splendid shape by the same methods as in the spring plantings.

As many seeds as can be secured will be stored in sand for planting in the spring, 1905.

No definite conclusions are to be drawn from the work so far accomplished. There are not enough premises from which to deduct a right opinion, but the evidence so far is favorable to the renewal of forests on denuded lands by seed planting at small expense.

FOREST CULTIVATED.

The work of cultivating the forest area of the Reservation, as begun last year, was carried on as fast as the means would permit in connection with the other lines of work. About eighty acres were gone over the past summer. All the inferior trees, the worthless species and the excess over and above the number desired to form the permanent forest were cut out. Those left standing were pruned as seemed right for their best development and all the brush was leveled close to the surface to form a covering and rot into mold and form humus to retain the moisture and enrich the soil.

The work of this kind which was performed last year indicates by the good development this past summer that the plan is both right and necessary. The cutting out of the excess and worthless trees and the pruning afford such vastly greater chances for the trees remaining to develop that there can be no question as to its being the thing to do. The fact that the development is there and can be so plainly seen by any one is evidence for the argument that all the forested area should receive the cultivation treatment at the earliest possible time.

The indications at this date are that the summer and autumn are the best seasons to do the work. The sprouting from the stumps and the healing over of the cuts made in pruning is far more satisfactory when the work is performed in the summer and autumn than where it is done in the spring months. The winter time up till March is very satisfactory in the same points but not so satisfactory in completeness. In the winter time it is difficult to locate all the dead and dying trees and the different species which should be cut out owing to the absence of the foliage. The past year has shown that the work can not be successfully done in winter.

Scarcely a tree died from the cultivation effects last year. A few show the effects of the cultivation of the past summer. The

leaves withered and to all appearance the trees are dead, though the spring time may see their leaves put forth. The number thus affected is so very small that it attaches no significance of data against the theory. Taken in connection with the excessive drouth of the locality it is marvelous that so few were affected.

The only damaging evidence against the work is the opportunity afforded for disastrous fires. Every precaution is taken to guard against them. Notices are served on all land-owners adjoining the Reservation every September, which is the beginning of the season for starting fires. If fires can be avoided for a few years the danger will be over. Great credit is due the citizens of the community for the care they are exercising in guarding the Reservation against this danger. Considering the recklessness of former years in spreading fires in the same community it is significant to notice the interest manifested by them against fires in the entire vicinity. An incendiary spirit or an accident would be the only excuse for a fire's origin under the existing strong sentiment of the community for the success of the institution. A constant guard is kept by the employes during the danger season and better safeguards should be speedily perfected for controlling fire should it ever occur. Fire lines and drives should be made systematically throughout the Reservation.

FOREST UNCULTIVATED.

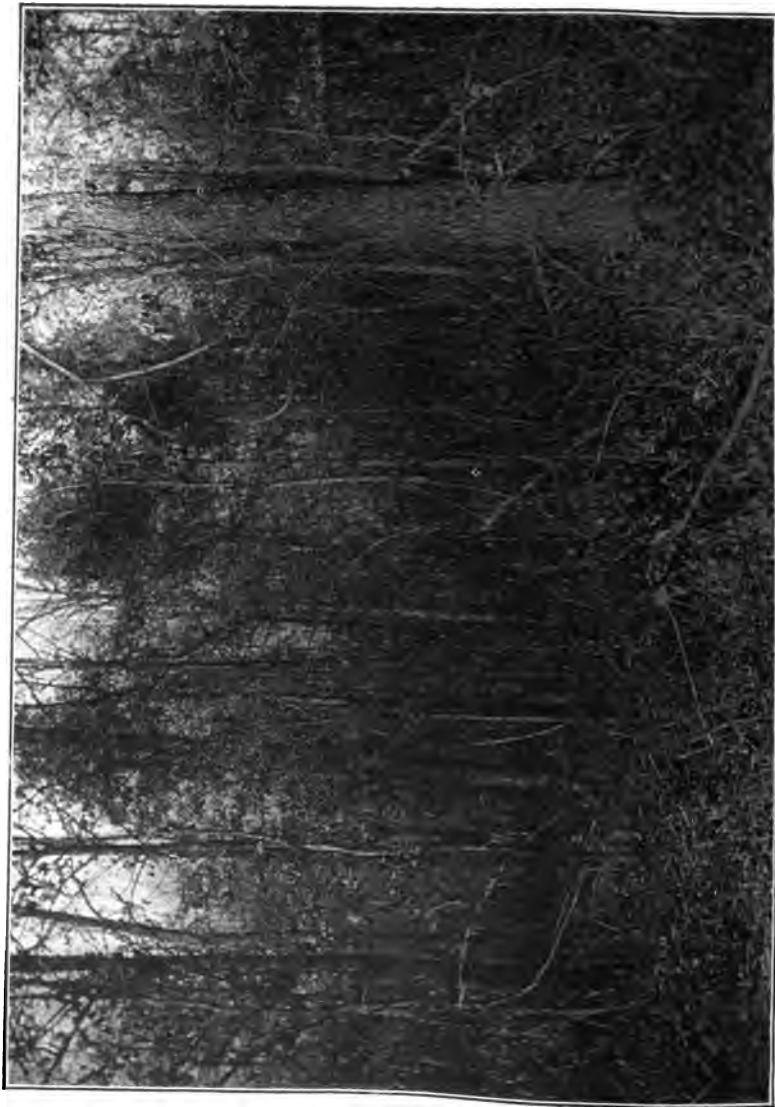
There remains of forest uncultivated about 1,200 acres. Four hundred acres is broken knob land and 800 acres is fairly level land. The entire area is densely grown up and should be cultivated without delay. There is scarcely any timber large enough for a good market value, but a splendid stand of the best hard-woods of from a few years to twenty years' growth is found on every acre of the area except in a few localities on the knobs where white pine of an inferior quality is abundant, and which is now coming into demand for railroad cross-ties, which, after being treated chemically, gives good use for such purpose. The extent of such pine areas aggregates about one hundred acres.

The condition of the greater part of the forested area which is uncultivated is a devastated one. It is a jungle of undergrowth composed of bad and good species in a dual strife for survival. It contains the rubbish of years of timber cutting, dead and in-



A view showing a portion of a cultivated woods on the Forest Reservation. This view shows the stand of prime hardwood trees retained after the excess and worthless trees have been taken out and the brush leveled to the ground. It was taken a year after cultivation and shows how well the brush levels and decays into humus and prevents undergrowth.

A view of an uncultivated woods on the Forest Reservation which is a type of the 1,200 acres which should be cultivated at the earliest date for its proper advancement.



jured trees by fires and storms, and briars and vines entangling all. Proper development of the desired, valuable species can not be expected until relieved of the hindering growth and rubbish. If this is done a fine stand of prime trees can be secured on all of the forested tract, and within a few years the cultivation will give them such an ascendancy as will enable them to overpower the excess and worthless growth.

The cost of doing this cultivation is about three dollars per acre. The income which can be derived from the fuel and such



A view of an abandoned field showing how it grows up in sumac and other worthless trees.

other sales as can be made will perhaps pay for doing the work.

The Board has spent none of its funds in attempting to market any products. Other work was more pertinent. An experiment was made, however, to determine the income which might be obtained from a frugal cultivation of the timber land and the marketing of the product derived therefrom. Portions were permitted to be cleaned up for the product, and a careful observance of the results justify the statement that for the greater part the cultivation of the woodland in the manner discussed heretofore

will return a dollar for every dollar so employed. The State would simply be loaning the money for the time it takes to do the work and remit. The gain to the forest thus relieved would surely justify the loan.

CLEARED LAND—UNCULTIVATED.

There remains of cleared land which has received no cultivation and which was abandoned by former owners for agricultural purposes, about 400 acres. It must not be understood that this land possesses no growing value, but that, having been farmed successively until weakened in producing strength, it was forsaken for new clearings. These fields were permitted to grow up for the most part in sassafras, sumac, briars and similar valueless species of plant life as usually take possession of abandoned land of its nature. Other portions are barren and very much eroded. These fields have received no attention for cultivation since becoming State property because every effort of the Board has necessarily been directed to the organization and the improvement of the tract and the immediate forestry work. The condition of the land, together with the limited demand for rental lands for farming has made it impossible to have the fields cultivated. It is desired that all these fields shall be put under forest cultivation at the very earliest time to prevent their becoming too waste and thus incur a large expense to reclaim them.

CLEARED LAND—CULTIVATED.

The cleared land which has been cultivated the past season is about 200 acres. Of this amount, as has been stated heretofore, 32 acres were planted in forest seeds this last spring and 101 acres were planted this fall. About 170 acres in the aggregate were rented for tomatoes, corn and oats this season at such rents as could be obtained, depending on the condition of the land. The planting done this fall was on the land cultivated in crops this season and performed after the crops were removed. From this source a small revenue will be derived, which will be paid into the State Treasury when received. Grain and roughness enough will be secured also from this source to feed the teams of the Reservation for the next year. The main items sought in renting the land this season were to get the ground prepared for plant-

ing and reclaimed from waste without much cost, as the ground is easily prepared after the crop is removed. This device was resorted to in order to accomplish as much with the appropriation as possible and to get all the lines of work under way. Much more would have been derived in returns from the rents had the season been favorable. Under the drouth conditions the crops were almost a failure. It is hoped to accomplish more from rents another season.

TREE PLANTING.

There were bought from a Wisconsin nursery company and planted last spring on the slopes and knob lands 10,000 standard white pine seedlings. Men with bundles of the small trees traversed the knobs and slopes and with hand-dibbles made excavations and planted them promiscuously in the favored places. It is feared, however, that the damaging drouth had its effect upon them as it did upon the seeds. Just what per cent. of them perished is not known and can not be ascertained at this time.

The grounds surrounding the buildings on Grandview Knob were carefully plotted and planted with trees for decorative purposes this last Arbor Day. Elm, ash, lin, gum, poplar, mulberry, maple, oak, pines and spruce were planted. There were 200 of such trees planted. These trees were of good size. Part were nursery-grown and part were forest-grown. The public schools of the township (Monroe) in which the Reservation is located and the citizens of the community turned out en masse and celebrated Arbor Day at the Reservation and participated in this tree-planting. Adjoining townships also sent delegates from their public schools to participate in this work.

The day is not to be forgotten, marked as it was by the high sense of appreciation and decided interest manifested by all present, and the Board kindly acknowledges the obligation and the service rendered them upon this occasion.

IMPROVEMENTS.

The improvements at the Reservation were forwarded as far and as completely as the appropriation would afford. They consisted of road-building, tearing away the old fences and grubbing out the old fence rows of years' standing, removing the old buildings and cleaning up the premises around them. The seventeen

farms, with their buildings and adjuncts, have been transformed into one tract of 2,000 acres without inside enclosures and buildings.

The road-building has consisted of the blazing and the cutting out of such roads as afford ingress to the main features of the site, putting in sewer and bridge crossings over the streams and ravines, together with the necessary gradings to the same and the widening and the repairing of the Knob road built to headquarters last year. A road was blazed, chopped out and crossings put in over the streams and ravines extending from the public highway on the eastern border through the mainland of the Reservation to the foot of the Knobs and connecting with the Knob road, thus affording a fairly convenient opportunity of driving to observe the main features of the tract. Additional roadways were outlined to enable access into other parts of the woodland. None of these roads are in any sense complete. They are crude, but all that could be accomplished.

The crude, old fences which were numerous on the site and were permitted to become dilapidated and densely grown up are, with few exceptions, now removed, and add a great deal to the appearance of the tract.

The buildings, which, like the fences, were permitted to go into decay or else were crude cabins, were razed and burned or permitted to be hauled away. The premises surrounding them were cleaned up so as to obliterate any disconnection with the tract as a whole. The fruit orchards were pruned and retained.

These latter improvement features, next to the forest cultivation, are the most impressive in elevating the appearance of the tract.

THE PROPOSITION.

The proposition which confronts the Board, and which it places before the people of Indiana for their consideration and decision through their representatives, the Governor and the members of the coming General Assembly, is one of the things to be accomplished; and the Board recommends that sufficient funds be appropriated by the coming General Assembly to do these things. The Board feels its own sense of honor and justification in the requests submitted and invites investigation. The whole proposition, stated in its parts, are as follows:

1. Twelve hundred acres of forest, which should receive systematic cultivation at the earliest date.
2. Four hundred acres of abandoned fields, which should be planted in seeds and trees without delay.
3. One hundred and thirty-three acres of land planted in seeds, which will require careful cultivation for the next few years.
4. Six miles of main roads, which should be built in a good, systematic manner, and double as many miles of lateral roads and fire lines for ingress and for fire protection.
5. Water reservoirs systematically established at different places on the Reservation to facilitate the plantings in time of drouth and as an essential adjunct to fire protection.
6. Border line fencing between the Reservation and adjoining land-owners, the one-half of which the owners themselves must build.
7. The erection of two and the remodeling of one residence building for the permanent employes needed constantly on the Reservation, and also, the building of suitable barns and sheds for the teams, implements and demands of the work.
8. General management, maintenance and equipment.

The statements here given as the parts of the whole proposition have been discussed in the foregoing details of this report, and hence need no further elaboration. The additional appropriation needed for the coming term of two years, in order to do the things necessary and essential to be done, is \$10,890, by careful and conservative estimates. The separate items and the amounts needed are as follows:

Forest cultivation, 1,200 acres, at \$3 per acre.....	\$3,600 00
Preparation and planting of 400 acres of fields to seeds at \$3.60 per acre.....	1,440 00
Cultivation of the 600 acres when fully planted in seeds for two seasons at \$1.50 per acre per season.....	1,800 00
Road-building—main, lateral and fire lines.....	1,450 00
Construction of reservoirs.....	250 00
Border line fences.....	350 00
Building improvements	2,000 00

The grounds for these requests are the possibilities and the value of the institution to the welfare of the State, and its value

as an investment. There is no longer a question raised as to the merits of the cause for which the institution stands, and there can be no longer raised as to the fitness of the institution and its value for the requests made for its advancement and completion. It, like any other State institution, could not be legislated into completeness at the beginning, but it was less possible in this case than many other of the State institutions because the location, the conditions, the needs and the possibilities were all unknown at the time the bill was formed for enactment into a law, and which was done by the General Assembly of 1903. Only a very conservative appropriation could have been proposed and accepted. The land conditions and the plan in the mind of the Board were the only definite elements known. After due consideration of several plans for maintenance and promotion of such an institution the Board decided on the plan as passed and the appropriation was placed at \$3,000 annually, the mere approximated sum needed to manage, investigate and determine the rightful appropriations required and bring the same before the next General Assembly, and which are as above given. The Board respectfully urges the allowance of the same, to be equally divided between the two years intervening between the close of the two Assemblies, 1905 and 1907. Thus the annual appropriation, therefore, will amount to \$8,445.

The institution as an investment alone will justify the appropriation for the improvement. The land values in the community of the Reservation have increased from two to three times since its establishment. This data is taken from the actual sales made within the past year, of which there were many, as compared with land sales before that time. The increment of the prime young forest with the increase of value with future time is an item of vast importance in considering the appropriations sought. The educational value for the cause of forestry to the people of the State by example and experiment is an element of consideration which can not be estimated in dollars and cents. The fact that it is State property justifies its being improved in a manner befitting the State. During the past year there were 911 visitors registered at the office of the Reservation. As the improvement is continued and the possible features developed the number of visitors will increase and the influence by direct contact will be much greater.



A view of white pine growing on the knob lands of the Forest Reservation.

REPORT OF WORK ACCOMPLISHED BY THE OFFICE.

THE MANIFESTED INTEREST IN THE SUBJECT OF FORESTRY BY THE PEOPLE OF THE STATE, AND RECOMMEN- DATIONS FOR FOREST PROMOTION.

The work accomplished in forestry by the office during the fiscal year was of the same character as that of the past few years; stimulating interest in forests, correspondence, forest inspections and recommendations and agitation by means of the public press, public gatherings and the mailing out of reports and bulletin publications bearing upon the subject. It is believed that all the efforts were fruitful of good results.

CORRESPONDENCE.

The correspondence of the past year was greater than that of any previous year in the matter of seeking forestry knowledge. The correspondents sought information of both a general and a special nature. The special inquiries indicated that a large number of individuals were devoting considerable attention to some special features of forestry, as the planting of trees suited for fencing posts, railroad cross-ties and similar uses, home tree planting for ornament and tree diseases. It also showed a considerable degree of interest in the work which was being done. The general inquiries were for literature giving a general knowledge of the subject of forestry, its purposes and opportunities, both as concerned the State and the National departments.

INSPECTIONS AND RECOMMENDATIONS.

The number of woodland inspections and recommendations made during the past year was not as large as last year, but the character of them were better in almost every detail. They possessed more of the elements of real forestry. There were thirty-eight personal inspections made by the Secretary and written recommendations rendered for woodland cultivation and pres-

ervation. There were made by the Secretary five inspections for park and ornamental home plantings and the plots and recommendations rendered for the same. In addition there were recommendations made by letter for forty-eight post timber plantings for farm uses.

It must not be understood that the number of inspections here given constitute the extent of the work done in the State the past year. They simply indicate the extent of the work in which the Secretary was called on for assistance. A great amount of forestry work was done by individuals who followed their own ideas or else sought information for guidance in the forestry reports and bulletins mailed them.

The decrease in the number of inspections for the past year, compared with those of the previous year, is traceable to the forestry exemption law of 1899 and the completeness of the instructions contained in the literature mailed from the office.

The previous year was the one in which forest exemptions were to be filed without question as to the legal time or year it should be done, and many sought to take the advantages afforded by that act and thus sought aid in order to have the claims allowed. The impracticability of the law, however, has caused woodland owners to abandon it, and hence the falling off in the demands for the inspection of forests.

The reports and bulletins mailed from the office were complete in instructions for forest culture and tree-planting of almost every feature, and consequently afforded the information heretofore sought by the request for a personal visit, inspection and recommendation.

AGITATION.

The subject of forestry was aggressively discussed before the people by the methods of reports and bulletin publication, public addresses, and by visits into almost every community of the State.

The Bureau of Public Printing published for the office of Forestry 7,000 copies of the annual report of 1903 and for the office of Public Instruction 15,000 copies of the Arbor Day Annual. The former, to the extent of 5,000, were mailed directly from the Secretary's office to addresses supplied by the presidents of the county farmers' institutes throughout the State. The latter

were expressed jointly by the offices of Forestry and Public Instruction to the county and city superintendents of schools, who in turn distributed them to teachers under their charges. By these means literature has been placed in the possession of the best citizens of every community. The remainder of the reports are being mailed daily as inquiry and requests are made for them.

The public press has been more than liberal with its columns in the publication of any matter pertaining to the subject, and great has been the influence for the good of the cause from this source.

The subject was also discussed before the county farmers' institutes, horticultural associations and literary and other club organizations by both local and assigned speakers. Personal visits were made into almost every community by the Secretary for the purpose of stimulating the cause and to determine the conditions and needs.

It has at all times been the decision of the Board that a thorough discussion of the subject before the people by every available means is the best way to promote the work. When the principles, the significance and the possibilities are instilled into the minds of the people, then the work of forestry will be advanced as it should be.

TREE PLANTING.

There are no statistics in hand to show the exact extent and kind of tree-planting done in the State the past year, but correspondence received from nursery firms indicate that it was greater than last year, and mostly of farm post timber trees and trees for ornament and shade around the homes and on lawns and public grounds. Nursery firms report that the demand and sale of such trees for Indiana exceeded the demands and sales for any other State, and that they could not supply the demands for seedlings of the former kinds of trees.

The indications, however, are that a splendid sentiment is forming favorable to the extensive culture of hardwoods for commercial purposes. It is only a question of sufficient time elapsing for the people to pass from the kindergarten features in which they are obtaining valuable experience to the larger work. It would be unreasonable to expect any other course from the people at this stage of forestry in this country.

THE PROPOSITION.

The amendments which were passed by the General Assembly of 1903 to the original law which created this department were such that the office is enabled to perform creditable work and give it a foundation. The funds now provided the office, in conjunction with the Forest Reservation and Forestry Experimental Station, afford the means by which the Board can investigate and experiment and give to the citizens of the State something of facts. No additional funds for either salaries or office expenses will be asked. The present appropriations by frugal expenditures are ample for the present needs. The increased appropriations asked for the accomplishment of the work at the Forest Reservation and Experimental Station are absolutely necessary and minimum and should be allowed.

The law of 1899 for the encouragement of individual forestry should be repealed or else amended to meet the aims and justice of such a law. The Board feels that there should be a law enacted which will exempt any land which the owner agrees to devote exclusively to forestry purposes, under given instructions and a specified contract between the exemptor and the State Board of Forestry, and to continue for a period of not less than ten years from the date of the filing of the exemption and so long thereafter as the instructions and the contract shall be fulfilled. The exemption should be in the nature of a rebate from the regular tax payment equal in amount to the sum of the taxes assessed against such land appraisement.

The requirements for exemption should be a defined number or an average thereof of standard forest-growing trees per acre at all times during the continuation of the contract. The number or the average thereof of growing trees per acre should be governed by the conditions, as whether the area is at the time of exemption a forested or a nonforested area. There should also be a specific agreement as to the protection and cultivation such forest should receive. The sales of all timber from such exemption should be taxed at the cash value received. The work of inspection and report of such exemption as to the faithful compliance by the exemptor with the instructions and agreement to the county auditors on or before the first day of June of each year should be performed by the road supervisors in their respective districts

at a stated fee per inspection and report, and any neglect or fraud on the part of the supervisors should be made an offense of misdemeanor and punishable by the existing laws for same.

Any violation on the part of the exemptor will be reported to the State Board of Forestry and the county auditor and the rebate of taxes discontinued by the county auditor until the decision of the Secretary of the State Board of Forestry that it shall be continued or discontinued, and such decision should be final.

Blanks for all applications for exemption, inspections and reports should be supplied by the State Board of Forestry so that uniformity of record could be easily kept.

A law of the nature here implied can be enacted legally, involving in its execution the Secretary of the State Board of Forestry, the county auditors and the road supervisors and of such simplicity of details that no difficulty will be encountered in its record. It will also prove a good impetus to the cause of individual forestry and will be just to all. The general effects of the same will justify its enactment, and such a bill will be formed and presented for enactment before the coming General Assembly.

THE RELATIONS OF FORESTRY AND LUMBERMEN.

The forestry question, which is now being introduced and agitated in the most vigorous manner that it can under existing opportunities, should interest no class of industrial people more than the lumbermen. They must look to the forests as the source of lumber to carry on their business. In dealing with the subject of forestry in its relations to lumbermen I call attention to the following facts:

1. That the lumber business is a large, important and legitimate one.
2. That every improved and conservative method of using the timber in the mills will further the lumber industry.
3. That the present method of handling timber in the forest is very wasteful and destructive.
4. That the present method is opposed to continuous forest management on timber tracts.
5. That communities have interests in the perpetuity of forests and their conservative use.
6. That the timber conditions in Indiana and elsewhere demand a more rational method in handling the forests for lumber.
7. That the forest owners and lumbermen as a rule do not understand that it pays better to protect a good forest in harvesting the timber crop than to destroy it.
8. That a knowledge of how to handle a forest rightly is not generally known or, if known, is not regarded.
9. That community interests and lumber interests, as now conducted, are in dual relations.

These concessions are facts which will admit of no successful contradiction. The enormity of the lumber industry is evident from the following statistics for the United States: The annual consumption of wood in the United States is 25,000,000,000 cubic feet. Of this amount 40,000,000,000 square feet is made into board lumber; 500,000,000 cubic feet for railroad car construction, and a like amount for fencing material. It is estimated that the

annual consumption of wood is 350 cubic feet per capita. As for Indiana, exact statements can not be given, but good reliable inferences may be drawn. Indiana a few years ago, according to the United States census, ranked fifth in the production of lumber. In 1898 the last partial statistics showed that 273,516,690 feet of lumber were sawed from the different varieties of timber in the State. I am told by lumbermen, in conversation, that the past year has been one of the largest in the lumber output, so that for Indiana the lumber business is still very great.

It is admitted, truthfully, that the improved methods of handling the timber, so far as sawing it with the least waste is concerned, leave little chance for improvement in most mills of any considerable capacity, but the great destruction and waste come in the handling of the timber in the forest. A visit to a tract of timber that has just been cut for lumber will show no signs of an attempt at economy in the saving of the young timber. It would be hard to find an example of more absolute destruction. The young growing timber is not regarded in felling the timber. It is cut and slashed for every conceivable convenience of handling the saw timber, both in cutting and handling. In many instances if the young timber had been carefully protected and let grow, in a very few years another good crop might have been harvested, as great or greater in value than the one removed. No attempt is made or even considered of continuing the tract in timber, and it is burned off and put into agriculture.

This absolute disregard for the right conversion of the timber and a failure to perceive that it would have paid better to have protected the forests in harvesting and continuing the forest tracts has brought us face to face with timber scarcity and damaged community interests of agriculture as well as that of lumbering. The lack of the knowledge of these things at a time when they might have been guarded has put community interests and lumbering in dual relation and forestry has for its purpose the arbitration of these interests.

Lumber dealers know more of the conditions of timber supply in Indiana than I. They as actual dealers know of its scarcity; but I am satisfied the following facts must be admitted:

1. That the large virgin poplar, walnut, ash, oak, and cherry no longer exist in abundance, to be purchased at any price in the hardwood district.



A view showing a white oak pruning made in the autumn of 1903 and the healing advancement of one season.

2. Trees are now anxiously bought at fancy prices which twenty years ago would not have been considered for fuel.

3. That regions abandoned as sawed up twenty years ago now have extensive mills and lumber traffic from the second crop to its almost complete exhaustion in the community.

4. That a large quantity of the finest hardwood timber is now imported in log form into the State and sawed or the lumber is imported.

5. That the greatest competition exists in every locality of timber supply outside the State as well as in it.

6. That so long as timber buyers have the cash and can offer enough they can buy except in very rare instances.

I do not care to submit any more of these facts for consideration. Lumber dealers may say truthfully that they have no trouble in getting all the timber they want; but the question is, How many years from now will they be able to get it? When every year sees vast areas of timber exhausted and put into agriculture and no attempt made to replant and cultivate, can it be possible that the end will never come? When less than 100 years has consumed 17,100,000 acres of the finest hardwood timber from our State, how long will the 1,500,000 acres left last? Prophecy based on past facts tells us that at the present rate, if no attempt is made at replenishment, the timber supply in the United States will last only sixty years. Such statements are not myths. In this country of progress, demand and consumption of every commodity are on the increase. Unless there is a change in the methods of timber dealings and an effort at replenishment made the timber supply must give out and the lumber business will be a thing only to be remembered.

It is for the prevention of the abuses of forests and the building up of right sentiments and inclinations that forestry was instituted. It is in these capacities that the relation of forestry to the lumbermen is found.

The law creating the Board of Forestry Department has defined the duties in a very general way. The duties stated as embodied in the law are: To collect, digest and classify information respecting forests, timber lands, forest preservation and timber culture, and to recommend plans for doing these things. The law further states that the Board shall recommend plans and methods for the



A view showing a reckless case of pruning on a young poplar and the careless hacking with an ax in the hands of an individual employed who had no interest in the work except the wages he received.

establishing of State forest reserves, and so far as practicable give out information on all the above phases of timber knowledge to associations and meetings of timber dealers, woodworkers, farmers and engineers of maintenance of way of railroads.

From the points of duty, as stated in the law governing the Board, the relation of forestry to lumbermen is a direct one. Timber promotion is the dominating element of duty. The things which should receive attention first, because of their relation to lumbermen, are the following:

1. Information should be collected and classified regarding the present forests so that people may know the real conditions in the State.

2. A rigid movement, legally, should be made to conserve and rightly use the present timber in the State.

3. An urgent movement should be made to perpetuate the present timber areas by cultivation and replanting, especially so in those parts of the State where the timber has become most exhausted.

4. The waste lands of the State should be planted in timber of the most valuable kinds suited to their soil and moisture adaptations.

5. The State should make wanton destruction of timber a misdemeanor punishable by law equal to the punishment meted out to offenders of our game and other natural resource laws.

6. Land-owners should be required by statute to keep and cultivate a fractional part of their estates in timber and to retain the same up to a given standard in numbers per acre.

7. The State should have legal powers in the hands of forest officers to enforce laws for the betterment of timber lands to rebound in their general effect to the State's welfare.

These suggestions may seem out of the question and unreasonable, but other nations of people who have in their past history been as lax as we in the conservation of their timber lands have been compelled for their general welfare to accomplish the things here mentioned and even by a much more extended and stricter policy than here outlined. They have also found it wise that they did so.

We as a State are now in the most prime condition to accomplish a great work in forestry which, if delayed, will mean much

greater outlay, effort and time to accomplish. In the State are sufficient timber areas, if proper treatment is compelled, to insure the State against a timber famine for the future. The present forests are in shape to be cultivated easily because of the excellent stock of seeds and young trees they afford. Rightly used they will furnish a continuous supply of good timber to the lumber trade equal to the present output. But unless this is done a timber famine must come to us as it has come to others. It may be in the future beyond our vision of time, but it must and will come unless a change takes place.

I think I may sum up the whole relation of forestry to lumbermen in the following statements, which outline the policy to be followed by the department in its work:

1. To promote in the best way the present timber lands in the State by insisting that they be conserved, cultivated and used in the right way.
2. To promote the planting of the waste lands in the State to timber of the most valuable commercial kinds suited to them in their soil and moisture conditions.
3. To have landowners plant and cultivate new forest areas for economic uses as an auxiliary to the saving of the present timber areas.
4. To recommend and induce such legislation as will insure a better respect for timber and timber promotion throughout the State.
5. To stand as a bureau of information in the best sense for all the phases of such, as is set forth in the law creating the Board.

In the doing of these duties it asks the united support of the Indiana lumbermen and every other intelligent organization in the State.

THE FARM WOODLOT—ITS PERPETUATION AND CAUTION IN TIMBER SELLING AND CUTTING.

The farm woodlot is properly receiving the earnest consideration of foresters at this time. As stated in foregoing articles, the commercial and extensive forest cultivation will be confined to the poor lands in the State which are unfit for annual crops and raising of stock. Such forestry will also be carried on largely by individuals and corporations who have sufficient means to successfully project and mature a long-lived industry, the returns from which are distant and cumulative. But a farm woodlot should be retained on every farm. It is not the intention to state the proportion of the farm which should be devoted to forest cultivation. At this time even a suggestion would be vague and indefinite. Forestry knowledge is too meager at this stage of propagation.

A vast majority of the farms of any extent in this State, outside of those in the prairie sections, possess more or less timber area, which is being retained as the woodlot portion. A casual observation of these farms disclose the fact that the greater proportion thereof is anything but valuable in timber resources. They possess but a limited variety of trees, and they are of the least valuable qualities. The whole consists of a jungle of tops, logs, wild briars, thorn, hazel and worthless underbrush. They may decently be called fragments. They are almost valueless for lumber use, likewise for fencing material. Their only value is in fuel and scanty pasture. Instead of being reckoned as values in farm sales, they are regarded as being worthless, and detrimentally affect the estimate of the entire farm.

Such woodlots do not pay for retention, and therefore should not be maintained. If a farmer has ten or twenty acres of such area, he should devote one-half of it exclusively to forest cultivation and the other half to pasture and agricultural purposes. The half retained, regenerated and cultivated in timber, according to the plan given below, will not only produce more and better tim-



A view of a chestnut oak pruning made in the autumn of 1903, showing the splendid healing effects of one season.

ber in after years, but will lend an aesthetic and systematic appearance to the farm, will provide an interesting and agreeable occupation to the owner, and be a valuable adjunct to the farm.

The time is at hand when a good growing timber area on a farm will greatly enhance the value of the land, the same as good fences, buildings and drainage. For some time past farmers have realized the scarcity of timber and the imperative necessity for conserving a portion of their woodland. To this end they have fenced off a portion that it might renew itself naturally with trees. Under favorable conditions as regards seed trees, shelter and humus soil such a plan will be fruitful of fairly good returns, but by securing the proper shelter, light, soil conditions and seeds, and by grubbing out the worthless kinds which usually spring up and choke out the valuable growth, the likelihood of gratifying and profitable results will be greatly augmented.

By following the method of timber cultivation and perpetuation prescribed a vast saving in area and in increase of product in both quantity and quality will result to the farmer, and the area retained will be a forest in the full meaning of the term. If the regeneration is unaided by systematic sylviculture the results will be tardy and the quality deficient. The process employed should be a combination of the natural and artificial methods. There are various systems proposed for regenerating such areas of forest as have been described. I am more favorable to the "strip" and "group" methods than to any of the others. I am confident that they more generally meet the conditions existing within the State. Under the "strip" system the regenerative process is conducted over strips instead of over the whole area to be cultivated.

The strips are treated so as to have three receiving attention at the same time; one being in the completed stage, one in the stage of seeding, and one in the stage of preparation. The breadth of the strips is determined by the influences under which the owner is acting. The operations should be begun on the most permanent side and extended one after another until the whole tract is treated. In this manner the work will be better done and different stages of timber will be growing.

The "group" system may be viewed as a modification of the "strip" plan. Under its working different patches are regenerated at intervals over the forest area, and these are then enlarged by



View of a chestnut pruning made in the early spring. Sap flowed excessively from the cut, insects and borers gathered therein and thus produced the scabby affects and damages to the wood.



A view showing a bad case of hickory pruning made in the early spring.
The bark checked loose from the wood, the limbs were severed
out from the trunk, the wood split and the bark
torn and peeled away.

the same three stages of operation till they converge and the whole area is thus regenerated. The main objection to this system is the unevenness of forest it produces. It is only a convenient means when good seed trees exist to spread out from them. In almost every forest some good trees are left standing which may be made nuclei for regenerating. It is a good plan where the varieties are desired in groups as opposed to a general mixture.

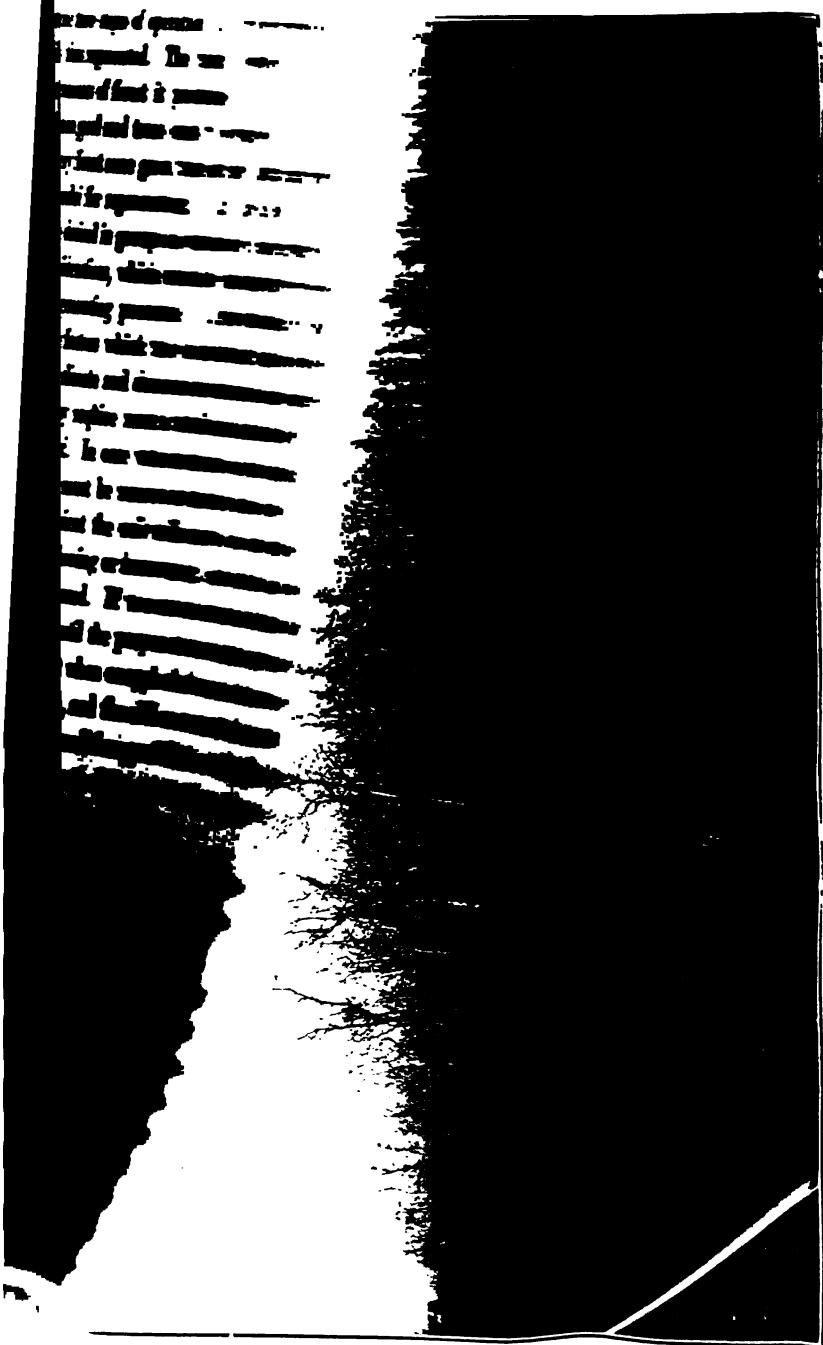
Many considerations, which should be carefully weighed, enter into these regenerating processes. The porosity, moistness and soil humus are factors which the soil itself must possess in right relations. The climate and denseness desired are other important features. It may require much artificial assistance to get these relations in accord. In case where there is too much humus and rubbish the same must be removed before the seed is sown. If the humus is deficient the soil will have to be worked by such means as hoeing, plowing or harrowing. In cases of sod the same course must be pursued. If too much shelter exists the timber should be removed until the proper shelter and light are secured. Good conditions exist when enough shelter is obtained to prevent weed and sod growth, and the soil is seen in half mixture with humus. When such conditions prevail the seed will sink readily into the soil, and the roots of the germinating seeds can penetrate for sustenance.

If these plans are followed, and good seeds are planted, the woodlot will be all that is desired and demanded and the whole country will be more valuable and beautiful.

In the retention of these woodlots, and that they may be easily perpetuated, there should be more care exercised in the matter of selling and cutting the crop when trees become ready for the market. Woodlot owners sometimes sell to a timber dealer all the saw timber on the entire tract, never thinking what may constitute saw timber in the estimation of the buyer. In this age of scanty timber supply anything that will square a four by four inch studing or make a box board is considered saw timber, and consequently a misunderstanding arises between the owner and the buyer. The owner finds his woodlot fairly denuded of any standing trees large enough for fencing posts after the buyer is through with his work. If the owner anticipated permitting the area to remain and grow up again for another crop he finds himself dis-

1. 100% 100%
2. 100% 100%
3. 100% 100%
4. 100% 100%

5. 100% 100%
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8. 100% 100%



A view of a 30-year old catalpa planting by the E. & T. H. Railroad near Sullivan, Indiana. This planting was first turned every year since planting, was not cut back to induce sprout growth and was planted on hard retentive red clay soil. The strip is a mile long and about 10 rods wide. It is all that could be expected under the conditions.

BLACK LOCUST PLANTING OF HON. Q. A. MYERS, LOGANSPOP, IND.

Mr. Myers has a black locust grove of 15,500 trees, which he planted for post purposes. On one division of his land was a sandy ridge, which washed badly, and was too loose for successful farming in crops. The land was crossed off, at distances of three feet eight inches each way, without even plowing the ground. With sharpened fork handles placed in the hands of boys holes were made in the checks by jabbing the handles into the ground for the planting of the trees. The seedlings planted were of one year's growth, and assorted to sizes of from twelve to fifteen inches high. At these sizes they possessed but one straight root, and, consequently, the planting was speedily performed. The trees were planted a year ago last May, so at present they are just in the middle of the second season's growth, but they will easily average ten feet in height.

The success of this planting is better understood when it is considered that the trees have never had any cultivation. They were simply left to themselves after being planted. It would have been better, perhaps, had they been plowed and trimmed during the first season or last spring, but the grove shows that the planting will be a great success without any care.

The expense of this grove was very small. The entire cost of labor to date is but \$10.50. The cost of the seedlings, which were secured from an Illinois nursery firm, was \$1.70 a thousand, making the total cost to date \$36.85. Unless some unexpected calamity befalls this locust forest, Mr. Myers estimates that he can begin harvesting posts in about six or eight years, and by the end of twelve years he can cut a full crop of an average of at least two posts a tree. The financial results of the grove seem assured at the present price of posts, or even at much less.

CATALPA PLANTING BY SENATOR JOHN W. PARKS, PLYMOUTH, IND.

In the spring of 1902 Senator Parks secured from R. Douglas & Sons, Waukegan, Ill., 5,000 young catalpa seedlings from eighteen to twenty-four inches high, at a cost of \$2.50 per thousand. In the spring of 1903 he secured from D. S. Lake, Shenandoah, Iowa, 10,000 of the same size and at the same cost, and this spring 2,500 more were purchased from the same firm. All of these trees were planted on his farm adjoining the city limits of Bourbon, Marshall County, Ind. The land selected was good, sandy, loose soil of fields which have been under good cultivation for many years, and is valued at from \$100 to \$125 per acre.

In May of each spring the ground was broken and prepared for planting in the same manner as for corn planting. The distances apart at which the trees were planted are five feet each way. The task of planting was easy and was personally supervised by the Senator. Each planter was supplied with a bucket containing trees and a spade with which to make the excavations and perform the planting. The buckets contained a slush of water and clay in which the roots of the trees were kept imbedded until removed at planting. The roots of the seedlings were not permitted at any time to become dry. Every detail of the work was carefully executed, and so successfully has it all proven that scarcely a tree is missing.

The cultivation since planting was very simple and inexpensive. The trees were plowed two or three times during the season and the weeds cut out. The first planting was cut back to the ground this last March to permit sprout growth for the future permanent trees. Senator Parks, like many others, was slow to consent to this treatment of his trees. He felt that it was throwing away all of the growth which the trees had made and the time spent in their cultivation, but results have convinced him of the wiseness of such a method.

The trees from the time of planting grew rapidly, but owing

to the nature of the catalpa to bush, little promise was shown of a good bole formation. They were small, spreading trees. The result of the sprouting from the cutting back is all that could be desired. Scarcely a stump failed to sprout. The only fault that could be found was the profusion of sprouts, owing to the fact that the trees were cut back in the season of vigorous sap flow instead of the season of dormant sap. In this particular the Senator was reluctant to obey orders, fearing that the stumps would fail to sprout if the cutting back were performed in the fall of the year. By this latter observance he would have avoided the profusion of sprouts.

In addition to the extensive growth is added the fine, straight, tapering boles giving every promise of relief from the natural stubby, branching proclivities of the tree. The average of the growth for the field is nearly five feet for the brief time.

The second planting shown in the photograph was cut back this fall for sprouting. It is better to allow at least three years' of root growth to form before cutting back, as the extensiveness of the same will add much to increase the successful sprouting in every way. The performance of this feature of the cultivation did not present any difficult work. A large pruning shear was the only implement necessary in the hands of a man to clip off the trees close to the ground as fast as he could walk to them. If the shear is kept sharp and the operator is apt, the cutting can be done quickly without splitting the stump or tearing the bark from it. The stumps were cut smooth and uninjured by tearing off the bark or splitting the wood, and thus the good results were obtained. The removal of the brush was a small task.

The work of selecting the sprout to form the permanent tree and the cutting away of the others required more work and caution than any other feature of the cultivation. A sharp knife blade was all the instrument needed in this work. The strongest, best sprout was selected to remain and all the remaining ones carefully cut away. At no time should they be torn off by the hand, as such process will split the bark from the stump and thus destroy the growing strength of it.

The same method of treatment will be given each planting when the proper time comes, and then the plantings will be allowed to grow unmolested to maturity for the purposes intended, which pur-

poses, by the Senator, are railroad ties and fencing posts. The chief attention that will need to be given them after one year from cutting back is a little attention to keep extra sprouting down and to protect the trees from outside harm of fires, stock and any other destructive agents.

THE RELATION OF FORESTS TO STREAM FLOW

By James W. Toumey, Collaborator, Bureau of Forestry.

INTRODUCTION.

For the purposes of the present discussion "forest" must be understood to mean a growth of trees sufficiently dense to form a fairly unbroken canopy of tops, not a scattered growth of low, round-headed trees with bushes and herbage constituting the dominant types of vegetation.

Forests of this kind do not occur in the United States where the mean annual precipitation falls below eighteen to twenty inches, except on restricted areas where unusual conditions prevail. The line of separation between the great eastern forest area and the plains approximately coincides with a north and south line marking a mean annual rainfall of twenty inches. The streams which rise in the Rocky Mountains and flow eastward are bordered by forests for long distances into the plains, where the annual rainfall is much less than twenty inches. These forests, however, are not so much a result of the rainfall in the regions where they occur as of surface and seepage flow from adjacent regions. The mesquite forests of the desert regions of Southern Arizona, where the mean annual rainfall is but eight to twelve inches, are made possible by the seepage and surface waters from the adjacent mountains.

The question of the exact relation which exists between forests and stream flow has long been under discussion. The broad fact that a relation exists is indeed indisputable. Forest destruction always produces a change in the character of the run-off. But the scientific determination of all the causes which produce this effect, and of their relative importance is a difficult and complicated matter. In spite of the fact that for many years European forest experiment stations have been carrying on observations, measurements, and experiments designed to clear up this subject, final conclusions covering the whole field have not yet been established. In this country almost nothing has ever been done to secure accurate

data for the investigation of this problem as a whole. Some light, however, has been thrown on the subject by means of a series of observations which have been going on for several years in the San Bernardino Mountains in Southern California. It is the purpose of the present article to make clear what are the various factors entering into the problem, and to state some of the more important facts that these observations in Southern California reveal.

In the San Bernardino Mountains records of precipitation for several years, at a large number of stations, shows that differences in forest cover are closely correlated with differences in rainfall. This correlation is so close that it is possible to judge the mean annual precipitation with a fair degree of accuracy from the appearance of the forest alone. In these mountains forests cover the slopes wherever the mean annual rainfall exceeds twenty to twenty-four inches; however, on southern and western slopes forests of equal density represent a larger rainfall than on northern and eastern slopes.

Other things being equal, regions having the greatest rainfall bear forests of the greatest density and luxuriancy of growth; but where the mean annual rainfall falls below eighteen to twenty inches, types of vegetation in which trees predominate are replaced by those in which shrubs and herbage predominate.

WHAT CAUSES RAINFALL.

Because rainfall is most abundant where forests grow, many believe that forests exert an important influence on the amount of precipitation. A more reasonable inference, however, is that rainfall is the great factor in controlling the distribution and density of forests.

Precipitation occurs whenever the air is suddenly cooled below the dew-point. The most effective cause of this is the expansion of air on ascending. The upward movement is caused very largely by cyclonic storms.

Whether forests have any appreciable effect in cooling the air to below the dew-point is uncertain. From the known effect of forests on the temperature and relative humidity of the air, it is reasonable to infer that they may have some such effect, at least to a small degree, and consequently that they may have some influence in increasing precipitation. The present evidence, however,

derived from many series of observations conducted in Europe and elsewhere, is so conflicting that a definite answer to this question, having the stamp of scientific accuracy, is not possible.

WHAT BECOMES OF THE RAINFALL.

That the excessive destruction of forests is followed by the drying up of streams and springs and by a diminution in the minimum flow of rivers is a well-established fact. The forest is the most effective agent known in regulating the disposition of the precipitation after it reaches the ground.

Rainfall escapes from the ground upon which it falls in five ways —through evaporation, transpiration, surface run-off, seepage run-off, and deep seepage. By evaporation is meant the moisture which passes into the atmosphere in the form of vapor from water and soil surfaces and from objects resting upon such surfaces, including vegetation. Transpiration is that portion of the rainfall which sinks into the soil, and which is later taken up by the vegetation through the roots and given off to the atmosphere through the stems and foliage. To this latter should be added, although not actually a part of it, the comparatively small amount of moisture taken up by the vegetation, but which through chemical change becomes a part of the organic vegetable structure. By surface or superficial run-off is meant that portion of the precipitation which, from the time of falling until its exit from the drainage basin, passes over the surface without gaining access to the soil. On the other hand, by seepage run-off is meant that portion of the rainfall which sinks into the earth, but which later reappears on the surface at lower elevations, and with the surface run-off escapes from the drainage basin in the streams. By deep seepage is meant that portion of the precipitation which sinks into the soil, but to such depths that it does not reappear later on the surface of the drainage basin.

. Evaporation and transpiration are frequently classed together as evaporation. In the irrigated parts of the West they are together known as "fly-off." So, also, the rainfall which does not escape through evaporation and transpiration or through deep seepage is often classed as run-off or stream flow.

DO FORESTS INFLUENCE EVAPORATION?

In order that the moisture which falls to the earth in the form of rain and snow should be most efficient in sustaining vegetation and in feeding streams, as little as possible should escape in the form of evaporation. Under the best of conditions a very large part of the annual rainfall is returned to the atmosphere through evaporation. For humid regions, bearing the same types of vegetation, the amount does not vary much from year to year, no matter what the fluctuations in rainfall are—a fact first made known by Messrs. Lawes, Gilbert, and Barrington in the classical Rothamsted investigations. These gentlemen explain this persistency in the rate of evaporation by the fact that heat and abundant rain seldom occur at the same time. Consequently, in a wet season, the lower temperature and more or less saturated atmosphere prevent excessive evaporation; while in a dry season, although the temperature is higher and the air drier, there is less water to evaporate, and the two extreme conditions balance each other so far as the amount of evaporation is considered. This is not true, however, in arid and subarid regions, because during years of minimum rainfall the upper layers of the soil are often so dry for months at a time that there is very little moisture to evaporate, while on the other hand during years of maximum precipitation the atmosphere is not sufficiently saturated to check rapid evaporation.

There is little or no difference between evaporation from a water surface and from any other surface that is thoroughly wet, when both are exposed to the same atmospheric conditions. The evaporation from a water surface is, however, always the same under the same conditions, but it is not the same from other surfaces, because they vary from completely wet to completely dry.

In the forest the crowns of the trees remain wet but a short time after precipitation. During this period, however, the evaporation is undoubtedly very rapid, on account of the large surface and from the fact that the crowns are exposed to the wind and the sun. But in a long series of investigations made at the Forest Experiment Station at Nancy, France, and recently published, it was found that a deciduous forest near that station held back from the ground less than 8 per cent. of the total precipitation. Although this is almost immediately returned to the atmosphere in the form of evaporation, it is a comparatively small amount of the annual rainfall. On

the other hand, evaporation from the soil in the open and in the forest continues often for long periods after the precipitation ceases. After the crowns become dry, evaporation is much retarded in the forest, because the forest floor is protected from the wind and sun. To such an extent is this true that the loss of moisture through evaporation is much less than that lost from an equally saturated soil or from a water surface in the open. Repeated European observations, extending over long periods of time, and shorter observations made in this country, conclusively show that evaporation from water or other wet surfaces on the floor of the forest is but one-third or one-fourth that from similar surfaces in the open. From the investigation of the moisture content of soils in the San Bernardino Mountains, the results of which are as yet unpublished, it appears that the first foot in depth of the mineral soil in the forest may contain two or three times as much moisture as soil of the same general character from similar situations in the open.

During the summer it is impossible to determine by actual measurement the loss of water from the soil either in the forest or in the open, because conditions as to moisture content constantly vary. During the winter, however, the evaporation from a snow surface can be measured with a fair degree of accuracy. Measurements made in the San Bernardino Mountains show that evaporation from snow surfaces may be four or five times as great as from water surfaces under similar exposure, and also that the rate of snow evaporation is profoundly influenced by the wind. In our Western mountains, where the snows are exposed to dry winds, the loss through evaporation is a large percentage of the total snowfall. In the San Bernardino Mountains, snowfalls a foot in depth are sometimes evaporated in two or three days without even moistening the soil. In so far as forests check the winter winds and provide shade, they lessen winter evaporation. This lessening of the evaporation from snow surfaces, through the action of forests, is seen in the fact that snows linger much later in spring in well-wooded regions than in open areas. It appears, then, that forests materially retard evaporation, both of soil moisture and of snow-fall.

DO FORESTS INFLUENCE TRANSPiration?

When land is covered with vegetation a certain amount of the rainfall is taken up by the growing plants. A small part, through

chemical change, becomes incorporated into the plant, but the larger part is returned to the atmosphere through transpiration. Although those who have investigated this subject are by no means in accord, there is reason to believe that considerable difference exists in the amount of water taken up by the different types of vegetation in the process of growth. On the whole, the forest probably takes up less water from the soil than the average agricultural crop. Risler, from a lengthy series of investigations, reached the conclusion that forests actually take up less than one-half as much water from the soil as the average agricultural crop.

The above would lead one to infer that where the soil, if not covered with forest growth, is clothed with grass or some other low form of vegetation, the return of moisture to the atmosphere, through evaporation and transpiration, or, in other words, the "fly-off," is less from the forest than from the open. But in regions having a short wet season followed by a long dry one the return of moisture to the atmosphere is probably greater from a forested area, because in the open for a large part of the year there is very little to evaporate, and the scanty growth of grass and other low forms of vegetation gives little opportunity for loss through transpiration.

THE INFLUENCE OF FORESTS IN REGULATING THE RUN-OFF.

Stream flow consists of both surface run-off and seepage run-off. Although these two can not be separately determined, total run-off admits of accurate measurement. Surface run-off may be considered as flood water, while seepage run-off is that portion of the drainage which gives the streams a sustained flow. It is evident that any factor which decreases the surface or superficial run-off and increases the seepage run-off is of the utmost importance in regulating the flow of streams.

The proportion of flood water to seepage is influenced by the rapidity of the rainfall. It is well known from direct observation that a slowly falling, prolonged rain, even on the naked soil of steep slopes, is all taken up by the soil. On the other hand, a heavy shower of short duration, falling on the same slope, may largely escape as run-off. In the first instance each drop has time to be absorbed by the soil, while in the latter the accumulation of drops is more rapid than the absorption, and the excess moves over the

surface to lower elevations. The forest canopy very perceptibly extends the period of time during which the rain reaches the soil, and in this way lessens surface run-off.

Again, forests, by checking the velocity of the wind and covering the mineral soil with a thick layer of dead leaves and other forest litter, effectively prevent soil transportation by both wind and water. On high elevations, where streams generally have their birth, the influence of the forest in this respect is of the utmost importance. So great is this influence that it exerts a marked effect upon topography. In mountainous regions particularly, the repeated destruction of forests permits the soil formed by the decomposition of the rocks at the sources of streams to be transported to lower elevations, with a consequent slow change in the details of the landscape. Such regions, if unforested, are apt to have precipitous slopes and scanty soil on the higher elevations. In that case there is no adequate medium to absorb the rain, and it flows over the surface. On the other hand, if such regions are well wooded, the slopes are less precipitous, and a considerable depth of soil usually covers the broad summits. As a result, the rain water is absorbed and the surface flow is reduced to a minimum.

Not only is it essential to have an adequate medium present to absorb the rain, but it must be of such character as to absorb quickly. The rapidity with which rain is absorbed is very largely governed by the physical properties of the soil, the organic litter upon it, and the vegetation. Decayed organic matter, by itself or in combination with mineral soil, absorbs moisture much more rapidly than soil containing little or no organic matter; hence, the greater the amount of leaf mold and other litter, the more rapidly will the rain be absorbed. Rapidity of absorption is also influenced by the degree of looseness of the mineral soil. In the forest the mulch of leaves and litter keeps the mineral soil loose and in the best condition for rapid absorption.

Not all the rain that is not absorbed by the soil where it falls reaches the stream by flowing over the surface. Much of it is taken up in passing from the place of falling to the stream. The amount taken up depends upon the obstructions in its pathway. Where there are no obstacles, as on barren ground, the moving water, by eroding channels, forms small rivulets, and these larger and larger ones, which flow with constantly increasing velocity. As a result,

the water passes rapidly over the surface, and but little gets into the soil. When the soil is covered with obstructions, such as are offered by a forest with its accumulation of litter and vegetable growth, the rain which is not immediately absorbed is checked in its flow over the surface. The water, being held back, is finally taken up by the soil and thus prevented from forming small rivulets through erosive action.

The forest, in extending the time during which the rain reaches the soil, in its effect upon local topography, and in supplying a larger and better absorbing medium, must necessarily have a profound influence in increasing the seepage run-off, and in proportionately decreasing the surface flow.

COMPARISON OF RUN-OFF FROM FORESTED AND NON-FORESTED AREAS.

There are so many complex conditions influencing the flow of streams that it is extremely difficult to determine the effect of forests on run-off by the comparison of the discharge of streams on forested and nonforested catchment areas. It is believed by many that stream flow is so largely influenced by the amount, intensity and character of the precipitation, the configuration and area of the catchment basin, the character of the absorbing medium and the underlying rocks, and the general climate, as well as the forest itself, that we shall probably never be able to measure quantitatively the influence of forests on the flow of streams by the comparison of forested and nonforested regions. Catchment areas differ so greatly in the features mentioned above that our most conservative and able investigators have been forced to the conclusion that "in respect to run-off, each stream is a law unto itself." Although the above is probably in the main true, yet, by the careful selection of small catchment basins for comparison, it appears that the influence of the forest in diminishing the surface run-off can be determined with a fair degree of accuracy. When the catchment areas compared are in the same region, are influenced by the same or nearly the same climate and precipitation and by the same storms, have approximately the same configuration and area, and have a similar mineral soil and underlying rocks, the effect of these various factors on the run-off can be ignored, and the differences in the behavior of the stream flow on the forested and nonforested areas

can be assigned to the influence of the forest.

In a careful study of the behavior of the stream flow on several small catchment areas in the San Bernardino Mountains, it has been found that the effect of the forest in decreasing surface flow on small catchment basins is enormous, as shown in the following tables, where three well-timbered areas are compared with a non-timbered one:

Precipitation and run-off during December, 1899.

Area of catchment basin.	Condition as to cover.	Precipita- tion.	Run-off per square mile.	Run-off in percent- age of pre- cipitation.
Sq. miles.		Inches.	Acre-feet.	Per cent.
0.70	Forested.....	19+	36-	3
1.05	....do	19+	73+	6
1.47	....do	19+	70-	6
.53	Nonforested.....	13-	312+	40

At the beginning of the rainy season, in early December, the soil on all four of these basins was very dry as a result of the long dry season. The accumulation of litter, duff, humus, and soil on the forest-covered catchment areas absorbed 95 per cent. of the unusually large precipitation. On the nonforested area only 60 per cent. of the precipitation was absorbed, although the rainfall was much less.

Rainfall and run-off during January, February, and March, 1900.

Area of catchment basin.	Condition as to cover.	Precipita- tion.	Run-off per square mile.	Run-off in percent- age of pre- cipitation.
Sq. miles.		Inches.	Acre-feet.	Per cent.
0.70	Forested.....	24	452+	35
1.05	....do	24	428+	33
1.47	....do	24	557+	43
.53	Nonforested.....	16	828+	95

The most striking feature of this table as compared with the previous one is the uniformly large run-off as compared with the rainfall. This clearly shows the enormous amount of water taken up by a dry soil, either forested or nonforested, as compared with one already nearly filled to saturation. During the three months here noted, on the forested basins about three-eighths of the rainfall appeared in the run-off, while on the nonforested area nineteen-twentieths appeared in the run-off.

Rapidity of decrease in run-off after the close of the rainy season.

Area of catchment basin. <i>Sq. miles.</i>	Condition as to cover.	Precipita- <i>Inches.</i>	April run-off per square mile. <i>Acre-feet.</i>	May run-off per square mile. <i>Acre-feet.</i>	June run-off per square mile. <i>Acre-feet.</i>
0.70	Forested.....	1.6	153—	66—	25—
1.05	.....do	1.6	146—	70+	30—
1.47	.....do	1.6	166+	74+	30+
.53	Nonforested	1	56+	2—	0

The above table clearly shows the importance of forests in sustaining the flow of mountain streams. The three forested catchment areas, which, during December, experienced a run-off of but 5 per cent. of the heavy precipitation for that month, and which during January, February, and March of the following year had a run-off of approximately 37 per cent. of the total precipitation, experienced a well-sustained stream flow three months after the close of the rainy season. The nonforested catchment area, which, during December, experienced a run-off of 40 per cent. of the rainfall, and which during the three following months had a run-off of 95 per cent. of the precipitation, experienced a run-off in April (per square mile) of less than one-third of that from the forested catchment areas, and in June the flow from the nonforested area had ceased altogether.

DO FORESTS INCREASE THE RUN-OFF?

Owing to the very complex nature of the investigation involved in determining the effect of forests on the amount of run-off, the available evidence does not admit a definite answer that will be of general application. It is reasonably certain from present evidence that in some regions the effect of the forest is materially to increase the run-off. It appears equally certain, however, that on other regions, and on certain classes of catchment areas, the effect of the forest is to materially decrease the stream flow.

Mr. Rafter, in his recent publication, "Relation of rainfall to run-off," makes this statement: "With similar rainfalls, two streams, one in a region having dense primeval forests, the other in a region wholly or partially deforested, will show different run-off. The one with the dense forest will show a larger run-off than the stream in the deforested area." This author concludes, from

Soil Survey

the stream flow on several
of the hills streams. It has been
shown that surface flow on
the hills streams is in the following
order: H_2O and with a non-

TABLE 1. *Soil Survey Report No. 10*

Soil Type	Time-of- runoff from soil surface		Time-of- runoff from soil surface
	mm. min.	mm. min.	
1	—	—	—
2	—	—	—
3	—	—	—
4	—	—	—
5	—	—	—

large amount of water on the soil
surface as a result of the long dry
periods, and runoff and soil on th
soil surface. The area of the ur
face runoff was only 60 p
cent of the total rainfall w

TABLE 2. *Soil Survey Report No. 10*

Soil Type	Time-of- runoff from soil surface		Time-of- runoff from soil surface
	mm. min.	mm. min.	
1	—	—	—
2	—	—	—
3	—	—	—
4	—	—	—
5	—	—	—



Rapidity of discharge of runoff after the close of the initial rainfall

Area of catchment basin. Sq. miles.	Condition as to cover.	Precipita- tion, Inches.	Δ precip. off past surface basis	Runoff in per cent	
				Runoff in per cent	Runoff in per cent
0.70	Forested.....	1.6	40.00	100	100
1.06	do.....	1.6	100	100	100
1.47	do.....	1.6	100	100	100
1.52	Nonforested.....	1	20.00	100	100

The above table clearly shows the importance of the condition of the surface in influencing the flow of mountain streams. The areas which, during December, experienced the greatest amount of the heavy precipitation for three consecutive months of January, February, and March, of the total of approximately 25 per cent of the total precipitation, were, however, the two areas of the same region. The additional evidence of the greater precipitation of 10.4 per cent in the month of March, in the basin of the stream which was nonforested, is further evidence of the influence of the condition of the surface in determining the amount of runoff.

RECENT PROGRESS IN TIMBER PRESERVATION

By Hermann von Schrenk, in charge of Forest Products, Bureau of Forestry.

INTRODUCTION.

During the past year interest in the subject of timber preservation has grown throughout the United States. At the present time there are no less than six large preserving plants under construction or under consideration. The increasing difficulty experienced in getting high-grade timbers, as well as the increasing prices of such timbers, has brought the question of the preservation of woods of lesser resisting powers to the front. In the past the long-lived timbers, like white oak, longleaf pine, and cedar were employed whenever resistance to decay was an important requisite. As long as these timbers were available in large quantities, it proved most economical to use them. Now that they are much more difficult to get, and consequently more expensive, the question is frequently asked: Is it practicable to use timbers which are not as resistant to decay, but which can be treated chemically; and, if so, what does it cost to treat them, and what length of life is it possible to get?

It is a matter of great importance to all users of timber to know (1) what timbers they can use; (2) how large the supply is; and, (3) how the poorer timbers, when once they are available, can be made more or less decay proof. This subject will therefore be considered from these three standpoints.

TIMBERS WHICH CAN BE TREATED.

Of the inferior timbers, that is, timbers of less decay-resisting powers, which it will probably pay to treat in one way or another, the following is a provisional list:

Some timber trees susceptible of preservative treatment.

Northern and Eastern United States.—Maple, beech, birch, hemlock, loblolly pine, red oak family, North Carolina pine.

Central United States.—Red and swamp oaks, beech, hemlock, tamarack, gum, loblolly pine, cottonwood.

Western United States.—Tamarack, lodgepole pine, red fir, hemlock, yellow pines, true firs.

These timbers are, as a rule, somewhat porous, and consequently, when properly prepared, will allow of a more or less complete penetration of a preservative solution. A large number of them grow with great rapidity and are therefore desirable trees to encourage in any plan involving forest management. Success in the use of any or all of the so-called inferior woods will depend almost entirely on the manner in which they are handled. It is absolutely safe to say today that, with proper preliminary preparation and proper treatment with a preservative, any and all of the timbers referred to above can be made to withstand decay for longer or shorter periods, depending upon the kinds of preservatives used.

Attention should be called to the statement that these timbers "will withstand decay." Preservative treatment will not protect

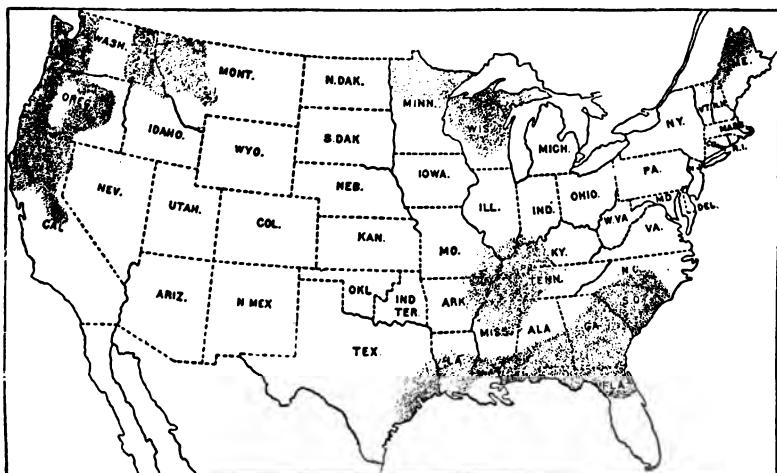


FIG. 46.—Distribution of large sources of timber supply.

a timber against mechanical abrasion. Red oak or loblolly pine treated with creosote will last indefinitely in the form of a fence post or telegraph pole, but both these timbers will wear out in the form of a railroad tie after a short period unless devices to protect their fibers are adopted. In other words, preservative treatment, as we know it today, protects against decay but not against mechanical abrasion.

SUPPLY OF INFERIOR TIMBERS AVAILABLE.

An important consideration which will determine to a large extent whether timber preservation will be practiced, relates to the probable supply of such timbers. While it is not possible to give

accurate figures as to the supply of any one timber, it is possible to point out in a general way where the great centers of forest wealth are. A glance at the map (fig. 46) will show this. In the New England States we can count on considerable quantities of birch, balsam fir, and maple. In the central Mississippi Valley there are large quantities of inferior oaks, beech, and gum. In the South the inferior pines have hardly been touched, while in Wisconsin and Minnesota the tamarack and hemlock are available in large quantities. In the Northwestern States, hemlock, red fir, tamarack, and true firs are found in great abundance. It appears therefore that there are still at hand large supplies of the inferior timbers, and that the centers of supply are widely distributed over the country.

Having found which timbers can be used, it becomes necessary to determine what will constitute a proper preparation for treatment.

HOW TO PREPARE INFERIOR WOODS FOR TREATMENT.

The object of a preliminary preparation for treatment is to make the wood as porous as possible. Most of the woods classed as inferior are more or less open grained, and for this reason are far better suited to preservative treatment than the high-grade timbers, which are denser. Freshly cut wood is full of water, contained largely in cell walls of the wood fiber. In addition to water the wood fibers of the sapwood contain certain small quantities of starches, sugars, albuminous substances, etc. Without going into details (discussed in full in Bulletin No. 41, Bureau of Forestry), it may be said that wood in which these substances are present is rendered less permeable by their presence, that is, most preservatives will not penetrate wood which is wet and full of organic matter. It has been found that the easiest way to make wood more permeable for preservatives is to season it thoroughly, either by ordinary air seasoning or by kiln drying.

The wood should be cut, so far as possible, in the winter period, that is, between October and March. Where possible the bark should be removed, which will not only hasten the seasoning, but will also lessen, if not prevent, insect attack. After the wood has been cut it should be piled in such a way as to allow the greatest amount of air circulation between the various pieces. This holds good whether the wood be for fence posts, telegraph poles, or rail-

road ties, or is in the form of sawed lumber. During the seasoning process not only does the water evaporate from the timber, but the various starches and albuminous substances are broken down, correspondingly increasing the penetrability of the wood.

The method of piling will depend largely upon the prevalent climatic conditions. In general, however, in extremely dry countries the timber will have to be piled more closely than in rainy countries, to prevent the too rapid drying out and consequent checking of the wood. In rainy countries excellent results have been obtained by building piles so that the upper pieces form a roof.

The length of time which is necessary to air-season wood varies with the climate and the season of the year. The tables following

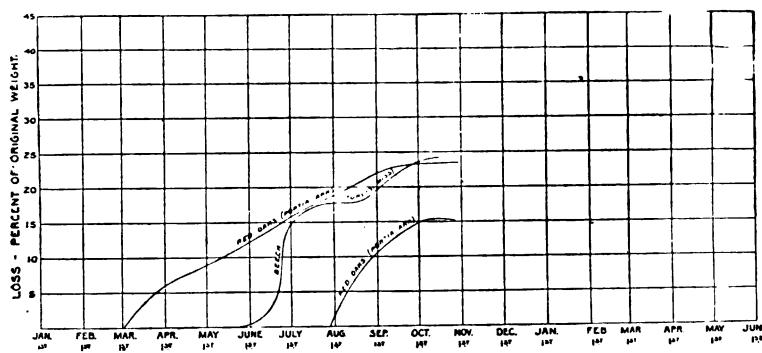


FIG. 47.—Rate of seasoning of red oak.

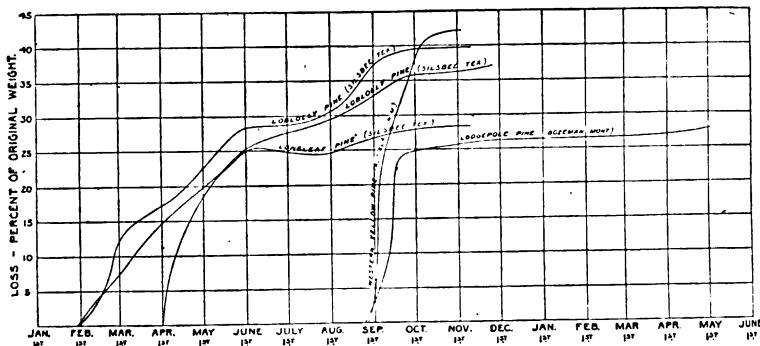


FIG. 48.—Rate of seasoning of loblolly, longleaf, and lodgepole pines.

and the diagrams (figs. 47 and 48) show this graphically. The curves in the diagrams show the rate of seasoning during the past year of red oak timber in Arkansas, loblolly and longleaf pines in Texas, and lodgepole pine in Montana.

Weights at successive dates of red oak ties cut in June, 1903, at Portia, Ark.

Date of weighing.	Average weight per tie.	Loss.
	Pounds.	Per cent.
June 30	184.5	.....
July 18	172.4	6.6
July 28	170.58	7.5
September 10	162.09	12.1
September 20	154.75	16.1
October 28.....	154.35	16.3

In Central New Mexico, where the climate is very dry and hot during the summer, timber dries with great rapidity, as indicated in the following tables:

Weights at successive dates of red pine ties cut in August, 1903, at Rociada, N. Mex.

Date of weighing.	Average weight per tie.
	Pounds.
August 18.....	184.0
September 3	124.8
September 18.....	112.1
October 9.....	107.5
November 5	106.4

Per cent of loss November 5, 42.2.

Weights at successive dates of black pine ties cut in August, 1903, at Rociada, N. Mex.

Date of weighing.	Average weight per tie.
	Pounds.
August 26.....	164.8
September 3	127.8
September 18.....	103.0
October 9.....	96.0
November 6	93.7

Per cent of loss November 6, 43.1.

The cost of holding wood while seasoning is at best a very small one, and in view of the very much improved treatment possible when wood is seasoned this cost need hardly be considered.

TREATMENT OF TIMBER.

The treatment of wood falls into several classes, according to the manner in which the preservative is applied.

Where but few pieces are to be treated, the preservative is often applied to the outside of the wood, either with a brush or by dipping

into the preservative. When wood is absolutely dry it will, in many instances, absorb in this way sufficient quantities of preservatives having any penetrating power, such as tar oils, spirittine, carbolineum, etc. These substances are excellent preservatives, and can be used to protect fence posts, car lumber, sills, and other structural timbers. Great care must be taken, however, that the wood is absolutely seasoned. All tar-oil products should be applied hot. Of the numerous products now being sold, for which the claim is made that they preserve wood absolutely by painting, only a very small number are of any value. Spirittine, carbolineum, and ordinary gas tar may be counted on as excellent wood preservers.

CORROSIVE SUBLIMATE.

The corrosive sublimate method of treating timber consists in immersing the wood in a solution of mercuric chlorid for a period sufficiently long to permit of more or less thorough penetration of the preservative. Excellent results have been obtained by soaking wood in a solution of corrosive sublimate (mercuric chlorid). This process has been extensively used in Europe for many years, particularly for smaller pieces of wood, such as posts, stakes, boards, etc.

The method of operation is extremely simple, and the original cost of the necessary apparatus is very small. A tank or vat is constructed of thick planks, carefully joined together so as to make the tank watertight. No iron must be used in building this vat, since it is quickly destroyed by the mercuric chlorid solution. The wood to be treated, which ought to be seasoned, is piled in this vat, and when the latter is almost full, by means of a series of clamps the wood is held firmly in position. The corrosive sublimate solution is then run in through wooden pipes from a neighboring storage tank, made also of wood. The solution is made by using one part of sublimate to 150 parts of water, the salt being first dissolved in a small quantity of hot water and then diluted to the proper point. The strength of the solution decreases as it is used, and must, therefore, be renewed by adding more sublimate from time to time. The liquid should stand in the vat so that it covers the wood at least an inch. As light affects the solution, it must be kept out by some sort of roof. The wood is left in the vats for from five to ten days, according to the size of the timber. Time should be given for thorough absorption by the wood before it is

removed. After the solution has penetrated for a sufficient distance into the timber, the wood is taken out and dried. As the sublimate is comparatively insoluble in water, it remains in the timber for a very much longer time than salts like copper sulphate or zinc chlorid.

Wood treated in this way can be employed with comparative safety for fence posts, stakes for grapevines, etc. The cost of treatment is about $4\frac{1}{2}$ cents per cubic foot of wood. In view of the small expense involved in putting up an apparatus to treat with this process, and the comparatively good results obtained, it is somewhat surprising that it has not been more generally employed by persons using small quantities of timber, who could not put up an expensive cylinder apparatus, such as is required for treatment with tar oil or zinc chlorid.

Caution.—Corrosive sublimate, or mercuric chlorid, is extremely poisonous, and care should be taken to prevent unnecessary handling of the solution, especially by persons not familiar with its character. In case of poisoning, the patient should at once drink milk in large quantities, or water in which well-beaten fresh eggs have been stirred—two to three eggs to a quart of water.

TAR-OIL VAT.

In many instances small pieces of timber, such as fence posts, grape-vine stakes, etc., can be treated with tar oil very much after the principle of the corrosive sublimate treatment. A small steel tank is used in many parts of Europe for this purpose. This tank is set in masonry in such a way that a fire can be built under it. Tar oil is poured into the tank, the posts or poles are set vertically in it, and a fire is started under it. As soon as the oil becomes thoroughly warm it penetrates into the timber for smaller or greater distances. Experiments on a considerable scale are now under way in this country to determine the exact length of time necessary to bring about a certain penetration, particularly with reference to fence posts. It is expected that preliminary results will be available in the course of three or four months. Attention should be called to the fact that treatment of this kind is possible only with absolutely dry wood.

TIMBER-PRESERVING PLANTS.

Where large quantities of timber are used, expensive and complicated preserving plants have to be built. These consist of steel

cylinders in which the timber is placed. The preserving solution is then pumped in and forced into the wood either under pressure or by boiling. Preserving plants of this kind are now being operated at a large number of points in the United States. Such plants should preferably be located at some point where large tracts of land can be purchased cheaply, so as to give enough room for piling to permit of the timber being properly seasoned. On that account it is generally poor policy to construct a plant of this character in or near a large city. Locating the plant at or near the center of the district from which the timber is obtained will not only prevent long shipments, but also will considerably reduce the cost of handling. The size of plant will depend largely upon the amount of timber to be treated.

The statement on the following page is a general estimate of the approximate cost of preserving plants of different tie-treating capacities. This will, of course, vary with the price of land, cost of steel, etc.

Approximate cost of timber-preserving plants of different capacities.

250,000 ties per year.....	\$40,000 to \$50,000
500,000 ties per year.....	50,000 to 60,000
1,000,000 ties per year.....	90,000 to 125,000

The majority of treating processes, with the exception of those noted below, use a similar form of apparatus, composed of a closed cylinder with a movable door, pumps, tanks, etc. The piping and the pressure limit of the cylinder may differ somewhat in minor details, but the same cylinder can be used both for zinc chlorid treatment and for the creosote treatment.

COST OF VARIOUS TREATMENTS.

The choice of the kind of treatment to be used will depend (1) on the original cost of the wood; (2) on the cost of treatment; (3) on the increased length of life obtained. Detailed accounts of the methods of treatment will be found elsewhere. At the present time it is of interest, however, to compare briefly the cost of the various treatments. For this purpose the cost of treating railroad ties is taken as a standard, since more attention is now being paid to them than to other classes of material.

CREOSOTING.

Creosoting, as it has been done in the past, is the most efficient and satisfactory method of preserving timber. Well-creosoted wood

is known to last indefinitely. Where a high-grade oil is used this treatment will in the long run prove the most satisfactory. At the same time it costs approximately 90 cents to \$1 to obtain a creosoted yellow pine tie. The scarcity of creosote, as well as its high price, has prevented its general adoption, but investigations are now under way to secure new sources of supply of this valuable material.

If we compare the actual cost of untreated white oak and creosoted red oak or creosoted loblolly pine, assuming that the untreated tie lasts ten years and creosoted tie twenty, we may establish the following:

Cost of untreated white oak and of creosoted red oak or loblolly pine ties.

Cost of tie and annual charge.	Untreated white oak (10 years' life).	Creosoted red oak or loblolly pine (20 years' life).
Cost of tie.....	\$0.85	\$0.40
Cost of treatment.....		.45
Total cost of tie .....	.85	.85
Annual charge on a basis of 4 per cent compound interest.....	.105	.063
Annual charge for renewal at a cost of \$0.19 for handling and placing .....	.016	.006
Total annual charge.....	.121	.069

The annual charges of untreated white oak, untreated red oak, and treated red oak are as follows:

For a white oak tie lasting 10 years.....	\$0.121
For a red oak tie lasting 5 years.....	.124
For a red oak tie creosoted, lasting 20 years.....	.069

These figures show that there is at this time a considerable saving in using creosoted inferior timbers, and this saving will probably increase as the years go on because of the appreciation in price of white oak, longleaf pine, and other high-grade timbers.

Where oil is used, success is possible only with a good grade of tar oil. To secure this, it is important to have some system of inspection which can be applied to every shipment, which shall be as simple as possible, and which shall effectively test the quality of the oil. The following specifications are now being urged for general adoption by the Bureau of Forestry, and indicate what is considered a high-grade oil by the best European standards:

- (1) The tar oil must be clear, that is, there must be no sub-

stances in suspension. This is best tested by putting a drop of the oil on a piece of filter paper.

(2) The specific gravity must be about 1.04 to 1.10 at a temperature of 20° C. The boiling points must be as follows: Up to 150° C. nothing must come off; up to 200° C. not more than 10 per cent. may come off; up to 235° C. not more than 25 per cent. may come off; up to 355° C. at least 90 per cent. must come off.

(3) The oil must be soluble in benzine or in absolute alcohol.

Attention is called to the fact that specifications 1 and 2 apply only to oils which are completely liquid at 68° F. (20° C.). Certain high-grade oils made in this country contain amounts of naphthalene and anthracene which render them solid at the temperature above mentioned. The specific gravity of such oils should be taken at 2° above their melting point. It has been found that some of these oils also contain a small amount of matter which is not soluble in benzene or absolute alcohol. This is probably due to the presence of small amounts of free carbon. The presence of one-half of 1 per cent. of such insoluble matter should not serve as a sufficient cause for the rejection of the oil. In making use of benzene as a solvent the insoluble portion counted should not include water, which in itself will not dissolve in or mix with benzene. On account of local conditions governing the supply and manufacture of creosote oils, the rejection of any oils should not be made on account of slight variations from the specifications.

Creosoting as it is now conducted in the United States consists of several operations. In the first place the timber is steamed, so as to allow the preserving fluid to penetrate into the wood more readily. The creosote is then forced into the wood under pressure. One operation takes from eight to twenty-four hours. It has repeatedly been urged by the Bureau of Forestry that when timber is thoroughly seasoned there will be no necessity for the steaming operation. In none of the European creosoting plants is steaming resorted to, and their results as regards the length of life are certainly beyond dispute. Recent tests made with creosote, and also with zinc chlorid solution, a substance of far less penetrating power than creosote, have borne out this contention in every respect, and it is urged that wherever possible the steaming operation should be omitted.

At the present time several new processes for forcing creosote

into the wood are being tried. Their purpose is largely to permit of a more economical use of this expensive material. While it is yet too early to give a definite statement as to their value, they may be briefly mentioned.

THE RÜPING PROCESS.

The Rüping process consists in forcing air into absolutely seasoned wood at a pressure of about five atmospheres. Without relaxing this pressure the creosote is forced in at a higher pressure, and a pressure of twelve to fourteen atmospheres is then maintained for several hours. When the wood has absorbed a sufficient quantity of tar oil all pressure is released. The excess tar oil in the wood is then forced out by the compressed air in it. The total quantity of tar oil absorbed by the wood under this method is very much less than with the ordinary system. Extensive tests are now under way to determine exactly how much of a saving can be effected by the use of this process, which promises to be very successful. It seems very probable at this date that the process can be carried out with very much lower pressures.

VACUUM STEAM PROCESS.

A process is now being tried in Europe which has so far shown excellent results in an experimental way. Absolutely dry wood is placed in a cylinder, and tar oil at a temperature of 70° to 80° C. is run into the cylinder. The oil is left in the cylinder from ten to fifteen minutes, during which time a small quantity is absorbed by the wood. The oil is then pumped out and a high vacuum is maintained for about an hour. At the end of this period steam under pressure of two atmospheres is introduced into this vacuum for one to one and one-half hours. The object of this steaming is to cause the small amount of oil which is forced into the wood at first to be more evenly distributed throughout the entire piece. The absorption of oil is extremely variable, depending upon the amount of sapwood in the timber. The process consists in the omission of the vacuum. A small quantity of oil is first pressed into the wood, the oil is then run out of the cylinder, and steam is admitted into the cylinder directly after this operation. This also is still in the experimental stage.

ZINC CREOSOTE PROCESSES.

Efforts are still being made in the direction of preventing the leaching out of zinc chlorid by adding tar oil to the zinc chlorid solution. The so-called Rütgers emulsion process is still used in Germany, but there is considerable objection to it because of the unequal distribution of the tar oil in the cylinders, the pieces of wood at the bottom of the cylinder receiving large quantities of oil while those near the top receive very small quantities.

Certain variations are now being tried by the Berliner Holzcomptoir, who add about 5 per cent. of wood tar, obtained from the distillation of beech wood, to the ordinary tar oil. This is said to make an emulsion with zinc chlorid of a more or less permanent character. In this country the injection of zinc chlorid, followed by tar oil (the Allardyce process), is being used to a certain extent with excellent results. The difficulty with all mixtures of zinc and tar oil is that with a single operation a poor tar emulsion is likely to result, while a double operation makes the treatment more expensive.

The cost of treating a tie with zinc creosote, as compared with the cost of an untreated tie, ignoring tie-plates, and estimating the life of the treated tie at sixteen years, may be given as follows:

Cost of untreated ties and of ties treated with zinc creosote.

Cost of tie and annual charge.	Untreated tie (5 years' life).	Treated tie (16 years' life).
Cost of tie.....	\$0.40	\$0.40
Cost of treatment.....	.25	
Total cost of tie.....	.40	.65
Annual charge on a basis of 4 per cent compound interest.....	.089	.066
Annual charge for renewal at a cost of \$0.19 for handling and placing.....	.085	.009
Total annual charge.....	.124	.065

THE SUGAR TREATMENT (POWELLIZED WOOD).

During the past summer an English inventor brought forward a process for treating timber with a strong sugar solution. The wood to be treated is boiled in the solution by introducing steam into a tank, which need not necessarily be a closed one. The boiling stops when all the air has been driven out of the wood. After treating the wood in the tank, it is dried gradually for several days,

special care being taken to prevent too rapid evaporation. Three points are claimed for the invention: (1) That the process renders timber tougher and stronger; (2) that green timber can in this way be rapidly seasoned; (3) that the timber is to a certain extent rendered decay proof.

It is probable that this process will prove valuable in the treatment of timber for purposes which will not expose it to moisture. Investigations to determine its actual value are now in progress.

ZINC CHLORID TREATMENT.

The cheapest preserving process, and the one most universally employed in this country, is the treatment with zinc chlorid. The great difficulty with this salt is that it leaches out so rapidly from the wood. Numerous improvements in the manner of treating wood with zinc chlorid have been made in the last year. It has been found that by using absolutely seasoned wood it is possible to treat certain kinds of wood by introducing the zinc chlorid solution directly into the tie without the preliminary and customary steaming. In this connection it is important to remember that the principal object sought is to obtain the greatest possible penetration of the preservative. The amount of dry chlorid absorbed can be regulated easily enough by varying the strength of the solution. For the present the customary $2\frac{1}{2}$ per cent. solution is recommended.

The following shows the result of some tests made at the Las Vegas treating plant of the Santa Fe Railway, and may serve as an illustration of the subject just referred to:

RECORD AND RESULTS OF RUN.

Vacuum begun.....	5.50 p. m.
21 inch vacuum	6.50 p. m.
ZnCl ₂ pumped in	6.50 p. m.
80 pounds pressure reached at.....	7.15 p. m.
Started forcing back.....	10.15 p. m.
Completed	10.33 p. m.

Ties weighed morning after treatment.	
Total weight of ties before treatment (118 ties used), pounds.....	10,602.5
Average weight of ties before treatment, pounds.....	89.9
Total weight of ties after treatment (without steaming) pounds.....	21,396.5
Average weight per tie after treatment, pounds.....	181.3
Gain per tie, per cent.....	101.7

If we compare the cost of inferior timber ties, estimating their life at five years, with that of the same kind treated with zinc chlorid, making the very safe assumption of a ten years' life for them, and again with the same number of ties made from a long-lived timber, untreated, estimated as giving ten years' service, we get the following approximate figures:

Cost of treated and untreated ties of inferior timber and of untreated ties of long-lived timber.

Cost of tie and annual charge.	Untreated tie.		Treated tie.
	Inferior timber (5 years' life).	Long-lived timber (10 years' life).	Inferior timber (10 years' life).
Cost of tie	\$0.40	\$0.85	\$0.40
Cost of treatment.....			.16
Total cost of tie.....	.40	.85	.56
Annual charge on a basis of 4 per cent compound interest.....	.089	.105	.069
Annual charge for renewal at a cost of \$0.19 for handling and placing .....	.035	.016	.016
Total annual charge.....	.124	.121	.085
Annual charge for 500,000 ties.....	62,000	60,500	42,500

The principal points considered may be briefly summed up as follows:

(1) It is more profitable to treat inferior, cheap timbers, such as loblolly pine and red oak, than longleaf pine and white oak, as the latter timbers take treatment very poorly.

(2) It will pay better in the long run to treat these inferior timbers with a preservative, for the annual charge is thereby brought down to a lower point than when untreated timbers are used.

(3) All timbers should be thoroughly seasoned before being treated. Seasoned timber not only takes treatment better and consequently has longer life, but it is also easier to handle.

(4) For the present, the following preservatives are recommended:

For Fence Posts.—Fence posts, if they are to be preserved, can be either charred or treated when absolutely dry with such substances as carbolineum, spirittine, or tar oil. They can also be soaked in corrosive sublimate. Telegraph and telephone poles can likewise be treated by applying hot tar oil, carbolineum, or spirittine.

For Structural Timber.—When structural timber is to be used in large quantities, and where the odor is not objectionable, this

class of material should be treated with creosote, using about ten pounds of tar oil per cubic foot. Where only a slight protection is necessary, tar-oil products can be applied from the outside provided the wood is absolutely dry.

For Ties.—The treatments recommended for ties at present are three: Creosoting.—The creosote should be of a high grade, as per specifications already given. About ten pounds of oil should be used per cubic foot. Zinc Chlorid.—Zinc-chlorid treatment is the cheapest recommended at the present time, and the only modification suggested as to its use is the omission of the steaming stage whenever, after sufficient trial, it is found that this can safely be done. Zinc Chlorid and Tar Oil.—The treatment of porous timber with zinc chlorid, followed by a treatment of three pounds of tar oil, is recommended as a process which will give good results. It is probable that within the next six months one or another of the new processes will have been tested sufficiently to warrant its being recommended.

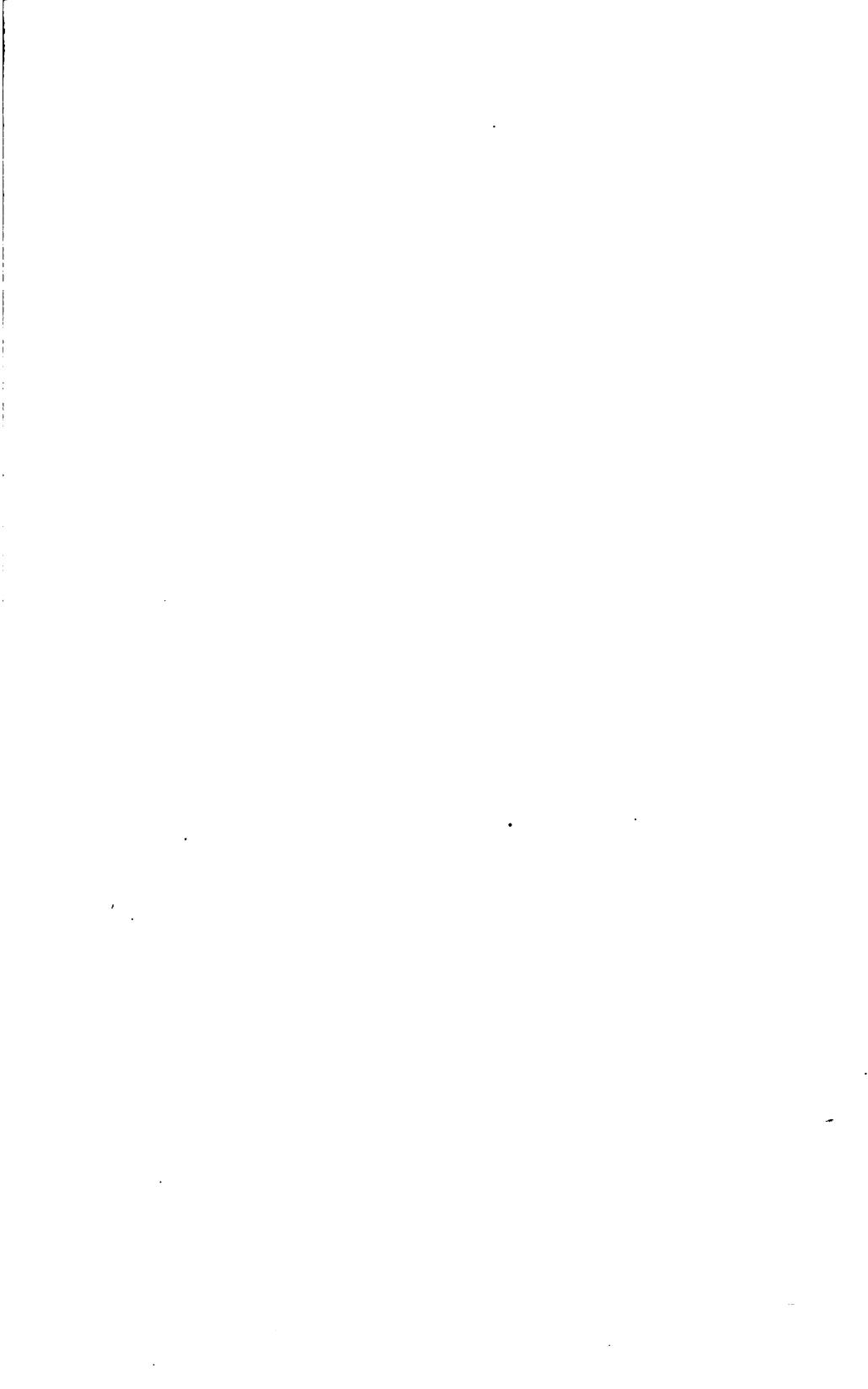
For Piling.—The only treatment recommended for piling is the tar-oil treatment. This is true whether the pile is to be used in structural work on land or for marine work. The only difference between the two is that piling used in marine work ought to have very much more tar oil. The following quantities of tar oil per cubic foot of timber are recommended: For use in fresh water, 16 to 18 pounds of tar oil; for salt water, in the latitude of New York, 12 to 14 pounds; between New York and Florida, about 20 pounds; and for Gulf points, 22 to 25 pounds. For Pacific coast points larger quantities of oil are required in northern latitudes than for Atlantic coast points; so at Seattle at least 20 to 22 pounds of oil per cubic foot should be used. The tar oil used for marine wash should have a high percentage of naphthalene.

In general, the porous woods should have preference. It will pay better in the long run to use treated loblolly pine for piling than longleaf pine. The unsatisfactory results obtained by many with creosoted piling can almost always be traced to poor treatment with poor material.

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